NAVAL POSTGRADUATE SCHOOL
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THESIS

IMPLEMENTING E-GOVERNMENT: A CASE STUDY OF IMPROVING THE PROCESS FOR TRANSFERRING CONVENTIONAL AMMUNITION AMONG THE MILITARY SERVICES

by

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While the Internet and related advances in communications technology provide significant opportunity for the federal government to vastly improve the delivery of information and services, success ultimately depends on government managers effectively redesigning industrial age processes for the information age. This thesis is intended as a guide for government managers interested in redesigning processes for the information age. Using a case study of a Department of Defense process for transferring conventional ammunition among the military services (cross-leveling), we demonstrate improved intra-governmental efficiency and effectiveness by employing best practices in business process redesign. After providing an overview of the existing cross-leveling process, each stage of Business Process Redesign is discussed and applied to the cross-leveling case. Activity Based Costing and Knowledge Value Added are used in evaluating the existing process and for providing a measure of process improvement. Using a three-tier architecture, a prototype application was constructed to help visualize the redesigned process and demonstrate the underlying technology. The concepts and processes used in the cross-leveling case study can be easily applied to other government processes.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABC	Activity Based Costing
ADO	Active X Data Objects
AMC	Army Material Command
ANSI	American National Standards Institute
ASP	Active Server Page
BPR	Business Process Re-Engineering
CRM	Customer Relationship Management
DODIC	Department of Defense Identification Number
DSN	Data Source Name
EDCA	Executive Director for Conventional Ammunition
ERP	Enterprise Resource Planning
GAO	Government Accounting Office
HTML	Hypertext Markup Language
IT	Information Technology
KVA	Knowledge Value Added
ODBC	Open Database Connection
OEDCA	Office of Executive Director, Conventional Ammunition
OMB	Office of Management and Budget
PMC	Presidential Management Committee
PPBS	Planning, Programming and Budgeting System
ROK	Return on Knowledge
SMCA	Single Manager for Conventional Ammunition
SQL	Structured Query Language
SWOT	Strengths, Weaknesses, Opportunities and Threats
WLMP	Wholesale Logistics and Management Program

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I. INTRODUCTION

A. BACKGROUND

Nobel laureate, Robert Solow, professor emeritus of economics at the Massachusetts Institute of Technology (MIT) said more than a decade ago *"We see the computer age everywhere but in the productivity statistics"* (Kolbasuk McGee, 2000). Many economists, including Federal Reserve Chief Alan Greenspan, have long agreed. In fact, the phrase *productivity paradox* was widely associated with information technology investments, as many yielded little or nothing to companies' results, despite the infusion of significant capital.

1. Overcoming the Productivity Paradox

More recently however, MIT, the Federal Reserve, Robert Reich (former secretary of labor) and other respected institutions and economists have concluded that information technology investments are beginning to produce significant productivity gains. It seems we are in the midst of a technological revolution. We have moved from an industrial economy to a service economy and fast-forwarded to an information economy. Over the coming years, information technology will become more central to our personal, business and national interests. While we do not always know how the technology will evolve, or exactly what changes it will bring, information technology is just beginning to reveal its full potential.

2. Power of Electronic Commerce

Companies became interested in electronic commerce for the simple reason that it offered the potential to increase sales and decrease costs, thereby increasing profits. Businesses found that incorporating electronic commerce into their sales and order-taking processes could reduce the costs of sales and product inquiries. In 1998, the first year in which Cisco Systems online sales initiative was fully operational, Cisco made 72 percent of its sales over the Internet. Cisco estimated it avoided handling half a million phone calls per month and saved more than half a million dollars in its first year. Currently Cisco sells almost all of its computer and networking equipment through its electronic commerce web site (Schneider, 2002). To increase sales, companies found they could use electronic commerce to expand the storefront beyond traditional geographic

boundaries. Ed Yardeni, chief economist and global investment strategist at Deutsche Bank Securities in New York explains "One of the few constraints on business has been time and space. The Internet reduces this. It's virtual and real time" (Kolbasuk McGee, 2000).

Another benefit of electronic commerce is that companies were able to easily gather data on such things as customers buying habits and supplier performance. Companies learned that this data offered significant competitive advantage. By mining this data, Amazon.com and others learned they could create customized buying experiences and promotional offers aligned with individual customers buying patterns. Companies like Amazon.com, Ebay, Autobytel and Dell Computer emerged with Internet only business models that capitalized on the strengths of electronic commerce. Others including book retailer Barnes and Noble, and catalog retailer LL Bean supplemented their traditional storefronts and catalog operations with electronic commerce sites. Manufacturing companies like Boeing and Ford used electronic commerce to more efficiently manage their supply chains, thereby reducing transaction and inventory costs and responding more quickly to changing business conditions (Fingar, 2001).

3. Defining the Problem – Recognizing an Opportunity

Electronic government is really electronic commerce applied to government. It includes the concepts, processes, and technologies necessary for transforming the delivery of government services over the Internet. Electronic government encompasses many disciplines and successful implementation hinges on the cooperation and collaboration across these disciplines, making it a rather difficult strategic initiative. Notwithstanding the difficulties, electronic government offers significant potential for expanding government services and improving government efficiency.

B. PURPOSE OF THIS STUDY

This thesis examines the federal government's efforts for transforming the delivery of services through the Internet, known as electronic government, with an emphasis on improving intra-governmental efficiency and effectiveness. We argue the current strategy for electronic government is centered at the top echelons of government, while actual implementation is left for managers to figure out. For maximum effectiveness, the current strategy should be supplemented with a more bottoms-up

approach that involves the full collaboration and partnership of government program managers and information technology professionals. Using a case study of the Department of Defense process for transferring conventional ammunition among the military services, we show how intra-governmental efficiency and effectiveness can be improved by adopting such an approach. In short, we hope to gain additional insight into how electronic government can best be made operational.

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II. ELECTRONIC GOVERNMENT

A. NEED FOR ELECTRONIC GOVERNMENT

No other entity in the world compares in size, scope, and complexity to the U.S. Government. Its budgeted outlays were $1.9 trillion in 2001. A civilian Federal workforce of 2.7 million individuals plus 1.4 million Department of Defense active duty military personnel serves a diverse nation of more than 278 million Americans. To fulfill its constitutional mandates, the U.S. Government undertakes a wide variety of programs in order to (U.S. Office of Management and Budget: Financial Report of the United States Government 2002):

- Maintain strong, ready, and modern military forces.
- Provide homeland security.
- Provide critical international leadership.
- Contribute to energy security.
- Protect the environment.
- Boost agricultural productivity.
- Facilitate commerce and support housing.
- Support the transportation system.
- Help economically distressed urban and rural communities.
- Assist States and localities in providing essential education and training.
- Promote health care.
- Foster income security.
- Provide benefits and services to veterans.
- Administer justice.

Federal information technology (IT) spending in the United States will exceed $48 billion in 2002 and $52 billion in 2003. A significant portion of current federal IT spending is devoted to Internet initiatives, yielding over 35 million web pages online at over 22,000 web sites. While the federal government is the world's biggest spender on information technology, it has not achieved commensurate improvements in productivity, quality and customer service (U.S. Office of Management and Budget, Implementing the President's Management Agenda: E-Government Strategy, 2002). David Walker,

Comptroller General of the General Accounting Office estimates e-government investments (a subset of the government's IT budget) will reach $6.2 billion by 2005 and added that agencies are moving forward with e-government projects, but the projects are still relatively immature (O'Hara, 2001).

While the Internet and related advances in communications technology provide significant opportunity for government to greatly improve the delivery of information and services, these same technologies create challenges for government in redesigning industrial age processes for the information age. While some government agencies have successfully implemented new strategies and business processes, others languish with barely developed or incompatible information technology infrastructure and outdated processes (Chandok, et al., 2000). For example, after years of experience working with agencies, Peter Smith, president of a nonprofit organization that provides management advice to agencies concluded, "There has been alarmingly little progress in improving the process at the agency level" (Robb, 2002). As a whole, the federal government appears well behind the private sector in improving service delivery through the application of modern information technology. "Governments have barely scratched the surface as they consider their E-Futures, while the private sector zips by at E-Speed," concluded another report (Rohleder, 2000).

B. EVOLUTION OF REFORM

The federal government has been using computer networks, including the Internet, since the 1980's in an attempt to create more efficient and effective business processes. A progression of laws, policies and pronouncements has focused on improving government performance. Legislation, including the Government Performance and Results Act of 1993 (Public Law 103-62), and the Paperwork Reduction Act of 1995 (Public Law 104-13), helped establish information technology as a key enabler for government reform efforts. With the passage of the Information Technology Management Reform Act of 1996 (Division E of Public Law 104-106), it was government's acquisition and utilization of technology that became the subject of reform. In February, 1997, the Clinton Administration released a report entitled *Access America: Reengineering Through Information Technology.* This report described how the government would deliver business processes with more speed, less paperwork, and at a

lower cost. Finally, the E-Government Act of 2002 [Public Law 107-37] aims to enhance the management and promotion of electronic government services and processes by establishing a Federal Chief Information Officer within the Office of Management and Budget, and by establishing a broad framework of measures that require using Internet-based information technology to enhance citizen access to government information and services, and for other purposes.

C. MANAGEMENT AGENDA

President Bush's Management Agenda, released in August 2001, is in many ways a continuing strategy for reforming government and improving program performance. The strategy is comprised of fourteen initiatives where it is believed the Federal Government can make the biggest gains. Of the fourteen initiatives, five are classified as government-wide initiatives, meaning they apply to every department and agency. The five government-wide targeted areas are (U.S. Office of Management and Budget: Financial Report of the United States Government 2002):

- Strategic Management of Human Capital
- Competitive Sourcing
- Improved Financial Performance
- Expanded Electronic Government
- Budget and Performance Integration

Together, the above initiatives are designed to address the most important government deficiencies, that is, where the opportunity to improve performance is the greatest. With the context firmly in place, this thesis will direct its attention toward the fourth targeted area: *Electronic Government*.

1. Implementation Roadmap

On February 27, 2002, the Office of Management and Budget (OMB) released a report detailing the President's E-Government Strategy in more detail. In developing the E-Government Strategy, OMB created a task force to study the issues surrounding E-Government and to develop a roadmap for implementation. Specifically, the task force objectives were to (U.S. Office of Management and Budget, Implementing the President's Management Agenda: E-Government Strategy, 2002):

- **Identify key barriers** to the federal government becoming a citizen-centered E-Government, and implement actions needed to overcome these barriers;
- **Recommend highest payoff cross-agency initiatives** that can be rapidly developed;
- **Develop a technology framework** that provides for the integration of government services and information.

2. Barriers

The OMB Task Force cited the following "four major reasons that the federal government has been unable to increase productivity" (U.S. Office of Management and Budget, Implementing the President's Management Agenda: E-Government Strategy, 2002).

- **Program Performance Value**: Agencies typically evaluate IT systems according to how well they serve the agency's processes and needs—not how well they respond to citizens' needs. Systems are often evaluated by the percentage of time they are working, rather than the internal and external performance benefit they deliver to the programs they support.
- **Technology Leverage**: In the 1990's, government agencies used IT to automate existing processes, rather than to create more efficient and effective solutions that are now possible because of commercial E-business lessons learned.
- **Islands of Automation**: Agencies generally buy systems that address internal needs, and rarely are the systems able to inter-operate or communicate with those in other agencies. Consequently, citizens have to search across multiple agencies to get service, businesses have to file the same information multiple times, and agencies cannot easily share information.
- **Resistance to Change**: Budget processes and agency cultures perpetuate obsolete bureaucratic divisions. Budgeting processes have not provided a mechanism for investing in cross-agency IT. Moreover, agency cultures and fear of reorganization create resistance to integrating work and sharing use of systems across several agencies.

Careful examination of the above reasons reveals an important observation; the government's shortcomings have little to do with information technology itself. Rather, the shortcomings appear embedded in process, human, and organizational issues that are largely technology independent. In fact, Gartner Group research suggests that 75 percent of IT/Internet based Electronic Commerce projects fail for lack of good strategy and business planning (Cole, 2000). Those who witnessed the dramatic decline of technology

companies beginning in March 2000 are likely not surprised by these findings. After all, Pets.com, E-Toys, and so many other Internet headliners were using state-of-the-art technology when they ran out of money.

a. Deep-Seated Nature of the Barriers

The literature surrounding electronic government reveals an entrenched interconnected and deep-seated nature of e-government barriers. For example, the University of Maryland study cites *established, entrenched,* and *fundamental governmental processes* as serious obstacles, while the report of the OMB Task Force highlighted the government's *resistance to change*. Overcoming the bureaucratic power struggles, resistance to change by agencies and citizens, funding problems and technological challenges will be difficult and fully implementing the President's vision will likely take years, and the efforts of millions. More than six years after *Access America* was written, much work remains (Robb, 2002, O'Hara, 2001). Furthermore, it is a mistake to believe that technology is the answer to many of the government's woes. Others go further by arguing that there is a real danger in looking at Information Technology as a "silver bullet" in the quest for increased productivity (Housel, 2003).

b. Different Occupational Communities (Cultures)

Edgar Schein, Sloan Fellows Professor of Management Emeritus at the Massachusetts Institute of Technology, Sloan School of Management, and a well-respected organizational psychologist, offers vital insight into how organizations work. According to Schein, "In most organizations, there are three different major occupational cultures that do not really understand each other very well and often work at cross-purposes". Schein, categorizes these three occupational communities as 1) executives 2) engineers and 3) operators. Schein makes a compelling case that the divergent views of the world intrinsic to these different communities explain, "why organizational innovations either don't occur or fail to survive and proliferate" (Schein, 1996). According to Schein,

> Executives feel an increasing need to know what is going on and recognize that it is harder to get reliable information. That need for information and control drives them to develop elaborate information systems…" (Schein, 1996).

This may help explain the rise in popularity of Enterprise Resource Planning Systems (large, expensive and complex enterprise-wide information systems) help satisfy the executive desire for integrating all departments and functions across a company into a single computer application. According to a Conference Board Report, many major companies are having difficulty achieving effective enterprise resource planning even after a full year of implementation (Conference Board, 2001). Schein's theory may also help explain why these systems are notoriously difficult to implement. If the people in the different departments don't agree the work methods embedded in the ERP software are better than the ones they currently use, they will resist using the it or will want IT to change the software to match the ways they currently operate (Koch, 2002). It is safe to say that the difficulty in connecting strategy with implementation is not a particularly new problem, nor is it unique to government.

D. LIMITATIONS OF EXISTING APPROACHES

In this section, we more closely examine some common electronic government approaches and discuss their limitations. First, it appears most studies and reform strategies have approached the problem from the "executive" perspective described by Schein. For example a central authority peers down at the various governmental agencies and develops a list of problems or barriers that are pervasive throughout government. This list is then used to develop some recommendations or mitigation strategies. This is the strategy employed by the OMB Task Force and it yielded the following list of barriers and mitigation strategies (U.S. Office of Management and Budget, Implementing the President's Management Agenda: E-Government Strategy, 2002).

BARRIER	MITIGATION STRATEGY
Agency Culture	• Sustain high level leadership and commitment. • Establish interagency governance structure. • Give priority to cross-agency work. • Engage interagency user/stakeholder groups, including communities of practice.
Lack of Federal Architecture	• OMB leads government-wide business and data architecture rationalization. • OMB sponsors architecture development for cross-agency projects. • FirstGov.gov will be the primary online delivery portal for G2C and G2B interactions.

BARRIER	MITIGATION STRATEGY
Trust	• Through e-Authentication E-Government initiative, establish secure transactions and identify authentication that will be used by all E-Government initiatives. • Incorporate security and privacy protections into each business plan. • Provide public training and promotion.
Resources	• Move resources to programs with greatest return and citizen impact. • Set measures up-front and use to monitor implementation. • Provide online training to create new expertise among employees/contractors.
Stakeholder Resistance	• Create comprehensive strategy for engaging congressional committees. • Have multiple Presidential Management Committee (PMC) members argue collectively for initiatives. • Tie performance evaluations to cross-agency success. • Communicate strategy to stakeholders.

Table 1. OMB Task Force - E-Government Barriers and Mitigation Strategy.

This approach provides a high-level view and creates a unified direction, and therefore, is essential to achieving long-term success in implementing e-government. Nevertheless, this approach falls short of fully "operationalizing" e-government. Mark Forman, Associate Administrator of Information Technology and E-government at the Office of Management and Government, explained the typical evolution of e-government solutions this way:

> The first phase is to get the information on the web; that is the low-hanging fruit; it's pretty easy to do. The second phase is the re-engineering necessary to streamline the process; that is harder and takes longer (Robb, 2002).

1. A Coast Guard Example

The Coast Guard's experience with e-government (E-Coast Guard) is illustrative of the difficulties inherent in connecting the pronouncements and policies of central authorities (e.g., President, Congress, Agency Heads) with actual implementation. In a November 2002 written address to the more than 38,000 men and women of the Coast Guard, the Chief of Staff outlined a significant rift between the goals of E-Coast Guard and the ability to accomplish them (COMDTNOTE 5230, 2002).

First, he explained the strategy:

> Two years ago, the Commandant set a long-term course to create E-Coast Guard, a Coast Guard that is fundamentally innovative, nimble and technologically empowered in its approach to business processes and solutions.

He then explained the implementation gap:

- **Access is a problem**: Many of our policies and software deployment strategies assume all of our personnel have access to a Coast Guard Standard Workstation.
- **Connectivity is a problem**: Many units must rely on dial-up capability for basic access to the Coast Guard network and cannot interact with the Coast Guard Human Resource Management System.
- **Getting hard copy is a problem**: Some units have limited printing and copying capacity cannot provide copies of documents to members who need them.
- **Time is a problem:** The cumulative effects of mandatory source data entry and self-service have created a requirement for a significant investment of time at a computer, resulting in a zero sum game with other daily job requirements.

Finally, the Chief of Staff outlined a series of actions to address these problems. In summarizing the future of E- Coast Guard, he offered:

> We intend to take a round turn on technology in the Coast Guard. E-Coast Guard remains the goal. It must. We cannot walk away from technology. But, we must not allow it to manage us.

E-Coast Guard appears to be another instance of Schein's theory at work, and provides further evidence of his central point that "Decisions have to be put into a form that lower levels can understand, often resulting in 'translations' that actually distort and sometimes even subvert what the higher levels wanted" (Schein, 1996). Sadly, there is no easy recipe for solving the problems associated with the different cultures of the three occupational communities. However, "Organizations will not learn effectively until they recognize and confront the implications of the three occupational cultures" (Schein, 1996).

2. Addressing the Limitations

The e-government task force concluded, "A fundamental barrier to getting productivity from federal government IT is government's inherent resistance to change"

(U.S. Office of Management and Budget, Implementing the President's Management Agenda: E-Government Strategy, 2002). The University of Maryland stated established, "entrenched, and fundamental governmental processes pose serious obstacles to effective implementation." Finally, Schein explained three distinctly different occupational cultures might be underlying the whole issue.

3. Helping Managers

Given the difficult nature of the task, it is little wonder that only the low hanging electronic government fruit is getting picked (Robb, 2002). If we are to make substantial progress in implementing e-government, it seems we must do more to help managers. For example, we were unable to find any manager guides, job aids, or quick reference sheets related to electronic government. The government's relatively new portal for e-government (www.whitehouse.gov/omb/egov/) shows great promise. Already, best practices, and progress reports are available. A quick web search reveals a plethora of consulting firms with electronic government practices, including the usual suspects like International Business Machines (IBM), Electronic Data Systems (EDS), and BearingPoint (formerly KPMG). However, widespread use of consulting firms is not a cost-effective long-term solution, nor is it practical short-term solution for managers limited by a resource-constrained environment. Therefore, we will argue that the results of our thesis supported by the following case study will give these managers better insight and a means by which they can analyze their own processes. We will accomplish this by demonstrating:

- Mapping the existing process
- Identifying shortcomings
- Offering short and long term process improvements
- Supporting these improvements with quantifiable numbers

E. USING A PROOF OF CONCEPT, CASE STUDY APPROACH

As an opportunity to gain additional insight into the inner workings of e-government, the authors embarked on a proof of concept case study of an existing government process, in cooperation with real government managers. In addition to practicing their skills in developing an electronic government application under real-

world conditions, the authors believe this approach can help shape theories about electronic government. Our final goal was to help ensure that case study participants met their goals for an improved conventional ammunition transfer process, including a working prototype.

1. Case Selection

All cases are unique, but those cases with prototypical background characteristics offer greater opportunity for extrapolating results beyond the boundaries of the specific case (Van Evera, 1997). Equally important is that the case offer a richness of policy considerations relevant to the subject of interest. Perhaps most importantly, the case needs to provide ample opportunity for us to apply knowledge of information technology management principles gained throughout our course of study. The conventional ammunition cross-leveling process met each of these requirements.

- The case study called not only for a redesign in the process but also for a redesign in the process using information technology and a three tier architecture.
- The results of the case study would identify how the process could be done cheaper and more efficiently. “Cheaper” and “more efficient” are always important issues in policy considerations.
- While specifically focusing on cross-leveling, the results of the case study could be applied to other agencies throughout the government with similar situations involving the transferring of inventory.

The next chapter is devoted to examining this process in more detail.

III. CONVENTIONAL AMMUNITION CROSS-LEVELING PROCESS

A. BACKGROUND

The issue of excess ammunition within the Armed Forces has been present ever since the early days dating back to World War I.[1] However, major inefficient processes and wastes of stockpiled ammunition during the Vietnam Conflict led to a 1973 Government Accounting Office (GAO) investigation and report focusing on the steps necessary to improve the management and oversight of excess ammunition (U.S. General Accounting Office: Excess Ammunition 1973). In March 1975, the Secretary of Defense followed the GAO recommendation and consolidated conventional ammunition efforts within the Secretary of the Army. The Single Manager for Conventional Ammunition (SMCA) was established within the Army to centrally manage all conventional ammunition to avoid duplication among production facilities and manufacturing processes (U.S. General Accounting Office: Army Could Achieve Efficiencies by Consolidating Ammunition Management 1999).

However, the establishment of the SMCA did not address the numerous and disparate ammunition processing problems prevalent throughout the Department of Defense. On November 26, 1979, the GAO recommended in their report, "Centralized Ammunition Management – A Goal Not Yet Achieved," that a single command office be created to focus on integrating and coordinating the efforts of ammunition centralization among the Armed Forces. Furthermore, a subsequent Department of Defense Directive required that this command office be jointly staffed and its mission be dedicated solely to centralized management of the Army's SMCA mission (DODD 5160.65, Single Manager for Conventional Ammunition). Finally, in August 1981, the Office of the Executive Director for Conventional Ammunition (EDCA) was established through the Army SMCA charter and was approved by the Deputy Secretary of Defense in February 1983. The organizational reporting structure of the EDCA is shown below (U.S. General

[1] Ammunition requirements change due to wars, conflicts, newer technology, obsolescence and shelf life. As these requirements change, older ammunition might no longer be needed in such large amounts, or even be needed at all. This situation leads to the ammunition becoming long supply (excess).

Accounting Office: Army Could Achieve Efficiencies by Consolidating Ammunition Management 1999).

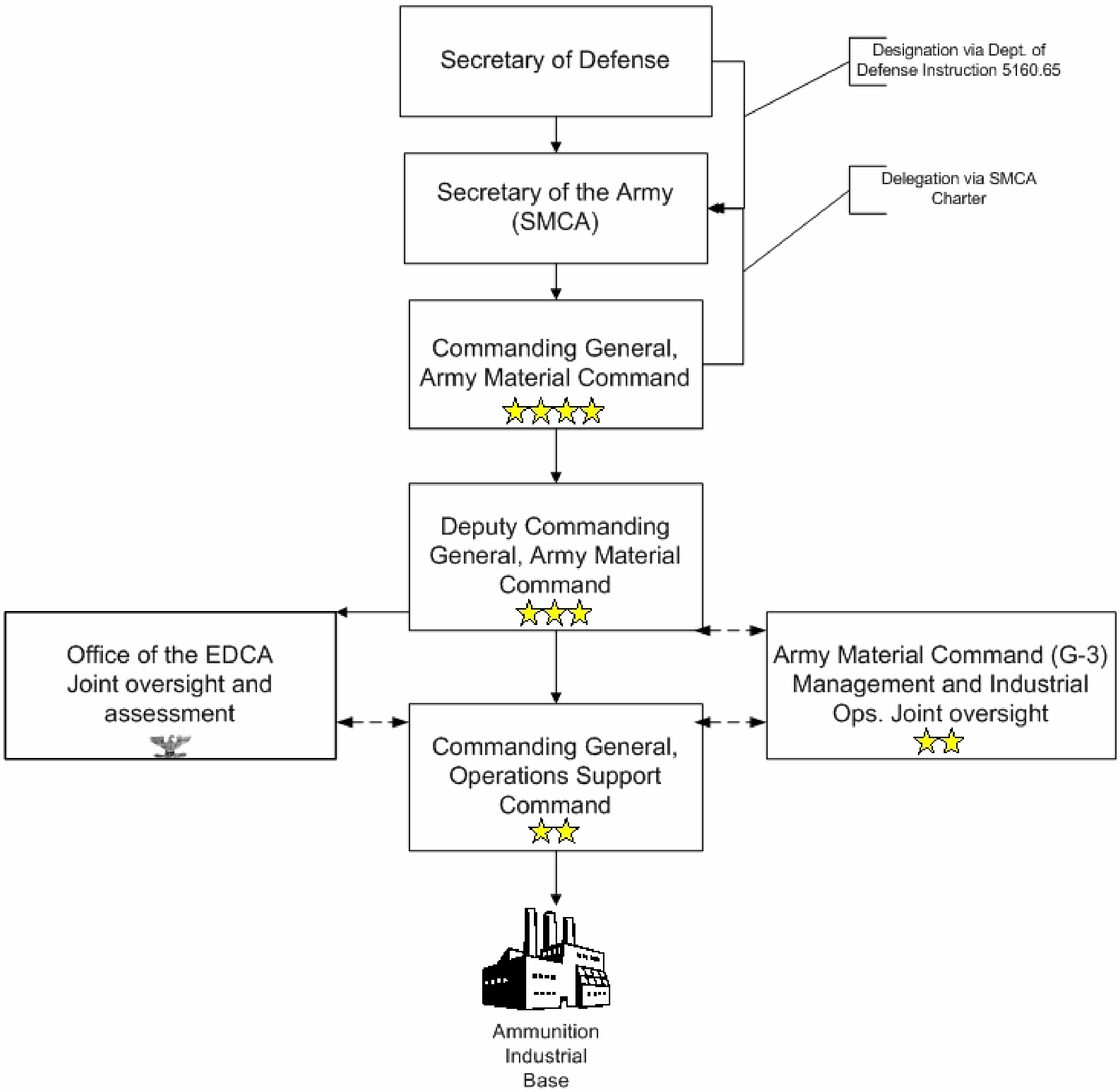


Figure 1. Organizational Reporting Structure, Office of the EDCA.

The mission of the Office of the EDCA is:

> Assist the Executive Director for Conventional Ammunition in the execution of the assigned mission to include: reviewing and assessing the Single Manager for Conventional Ammunition (SMCA) and related Services responsibilities, as well as participating in the Joint Service management of conventional ammunition under the single manager concept. (Smith, 2002).

The objectives of the SMCA are as follows: (DODD 5160.65, Single Manager for Conventional Ammunition)

- Achieve the highest possible degree of efficiency and effectiveness in the DOD operations required to acquire top quality conventional ammunition for U.S. forces during peacetime and mobilization.
- Integrate the wholesale conventional ammunition logistic functions of the Military Departments to the maximum extent practicable, thereby eliminating unwarranted overlap and duplication and increasing the efficiency and effectiveness of the overall conventional ammunition program.
- Maintain an integrated production and logistic base to meet peacetime, surge and mobilization requirements for assigned ammunition.

A small part in achieving this mission was the centralization of management within the EDCA for the cross-leveling of conventional ammunition among the Armed Forces.

B. CURRENT PROCESS

Cross-leveling describes the process by which the military services can exchange inventory of excess, or "long supply,"[2] conventional ammunition. Conventional ammunition is defined as "non-nuclear ammunition covering a wide variety of items from 5.56-mm. cartridges to 2,000-pound bombs. The majority of ammunition items have four major components--a metal body, an explosive, a propellant, and a fuze" (U.S. General Accounting Office: Centralized Ammunition Management—A Goal Not Yet Achieved 1979). The EDCA not only facilitates the cross-leveling process but also facilitates the gathering of statistical information on successful transfers of long supply. Planning, Programming and Budgeting System (PPBS) information from the Single Manager for Conventional Ammunition (SMCA) is listed for each long supply item as well. In essence, the PPBS provides the projected cost of purchasing the ammunition from the open market and is used to identify savings afforded through the cross-leveling process. Such savings are tallied each year and are compared to previous years to ascertain the effectiveness of the cross-leveling process for that year (Interview, Diane Smith).

[2] Long supply is determined by taking current combat requirement, current operations requirements and seven years of training requirements and comparing it to inventory. Exact criteria for "long supply" classification can be found in Department of Defense Instruction 3000.4 (Smith, 2002).

The current cross-leveling process is time consuming and complex. The following steps outline the process (Smith, 2002):

- Initially, the Coast Guard, Navy, Navy Special Operations Forces, Army, Air Force and Marines all submit separate spreadsheets called “stratification reports” created in Microsoft Excel detailing their lists of long supply ammunition.
- Next, the EDCA consolidates all this information into a single database created with Microsoft Access. Numerous reports are generated and saved as a single rich text format (*.rtf). This *.rtf file is then emailed to all the service representatives to be viewed using Microsoft Word.
- At this point, the combined long supply list is painstakingly reviewed in detail. If a service representative is interested in a particular type of long supply ammunition, he/she must request specific lot information such as the ammunition’s serviceability, location and quantity. This process is accomplished via multiple emails using Microsoft Outlook.
- An annual meeting is held in March at the EDCA Headquarters in Alexandria, VA, to review the available assets and the results of the previous years’ cross-leveling efforts. Typically at this meeting each item offered for cross-leveling is discussed and agreements are made concerning which Service has priority to receive the cross-leveled ammunition from the offering Service. Additionally, notes are compared and feedback is given to all service representatives detailing transactions, pointing out cost avoidances achieved by acquiring cross-leveled vice procured ammunition and discussing lessons learned to possibly improve the process for the next year.
- After the March meeting and once an agreement has been reached, the transfer of ownership and transport of ammunition, if necessary, is handled between the two commands managing Service-owned munitions. The transfers of ammunition are affected via transactions that transfer ownership or location as appropriate.
- Each quarter the Services report their completed transactions to the Office of the EDCA so the results can be tallied up and reported during the next fiscal year.

The process flow diagram for the current process of a typical transaction is shown below.

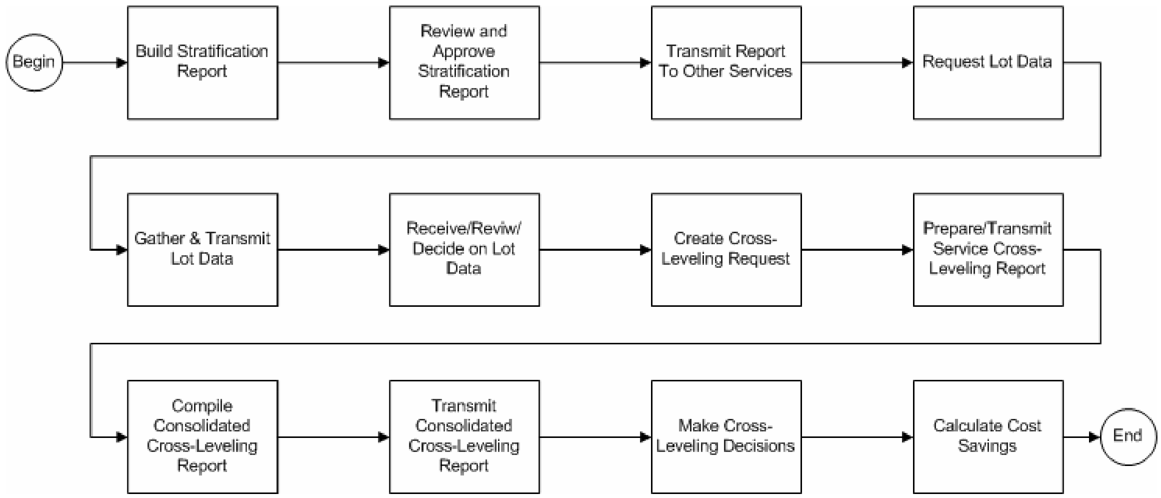


Figure 2. Process Flow Diagram - "As-Is" Cross-Leveling Process.

C. INEFFICIENCIES WITH CURRENT PROCESS

The current process has several shortcomings. First, the consolidation of all the spreadsheets into a single working database application requires approximately one work week. Furthermore, the efforts in creating the database are lost after the close of the fiscal year because a new database is created every year with new information. Secondly, the conversion of database reports into a *.rtf file is a time consuming process requiring much time and patience from both the sending and receiving parties. Moreover, when the service representative receives the 60 to 75 page *.rtf file, they must view it through a word processor such as Microsoft Word. However, it is difficult to search for items due to the size of the document and Microsoft Word's inability to sort and group entries, a task better suited for a spreadsheet.

Whether or not the service representatives choose to re-enter the data back into a spreadsheet to allow for better sorting abilities, the end result is a time intensive process to find specific ammunition information. Third, after a representative has located a type of ammunition he is interested in, he must send a query, usually via email, to the service representative offering that ammunition as long supply. From this point, specifics of the requested ammunition are related back such as where and how it is stored and its serviceability. While effective on a one-to-one basis, the process becomes repetitive when a service representative receives numerous emails over a long period of time. This requires him to find the original email sent and to re-send it to the other interested parties

or it requires him to research the information again because the original email is no longer available. Either way, the current means of communication is not as efficient as it could be. Finally, there is a time delay in informing the services as to the actual availability of a specific type of ammunition. For instance, assume the Army requests lot information on a certain type of ammunition from the Navy. Then assume the Army wishes to acquire the ammunition. In essence, this specific lot would be “off the market” for all other interested parties until the transaction with the Army is complete. However, some time down the line, should the Army decide to not accept the ammunition, it might be too late to re-offer its availability to the other services before they decide to procure their requirement from other sources.

IV. PROCESS IMPROVEMENT

A. OVERVIEW

A *business process*[3] is a coordinated and logically sequenced set of work activities and associated resources that produce something of value to a customer (El Sawy, 2001). From this definition, one may surmise that any process improvement will likely result in some combination of better coordination, better sequencing, consumption of fewer resources, increased process capacity, or greater customer value. Process improvements are carried out within an organizational context; which means the people, technology, organizational mission, form, and structure all play a role in organizational performance. Organizational context is an important component in deciding on the scope and approach of any process improvement effort. This chapter provides an overview of various process improvement approaches and methodologies and discusses how the conventional ammunition cross-leveling process was redesigned.

B. APPROACHES

Before undertaking a process improvement effort, it is helpful to understand the various approaches such as Continuous Process Improvement, which calls for incremental changes; Business Process Re-Engineering, a method that suggests starting over from a "clean slate;" and Business Process Redesign, which is a mixture of the first two. There is no best approach as the specific circumstances of the organization and process under review should dictate an appropriate selection. However, regardless of the approach used, it is essential to understand the current process before designing a new one for the following reasons: (Davenport, 1993).

- Understanding existing processes facilitates communication among participants in the innovation initiative.
- There is no way to migrate to a new process without understanding the current one.
- Recognizing problems in an existing process can help ensure that they are not repeated in the new process.

[3] Note: Unlike E-commerce and E-government, where different terms are used to describe similar ideas applied to business and government respectively, the term business process is routinely applied to both business and government.

- An understanding of the current process provides a measure of value of the proposed innovation.

It is imperative that the methodology and results of any process improvement effort are aligned with the objectives and strategy of the enterprise. Customer requirements, core competencies, perceived need for change, tolerance for risk, resource availability and preferred time horizon are but a few of the relevant considerations.

C. CONTINUOUS PROCESS IMPROVEMENT

Focusing on process as a way to improve organizational performance has progressed through various stages over the last 20 years. In the 1980's, Dr. W. Edwards Deming introduced the Japanese to Total Quality Management and continuous process improvement, thereby creating a quality revolution. In continuous process improvement, the idea is to improve the process through incremental changes suggested by those actually performing the process. This approach is decidedly low risk, as the types of process changes cost little to implement and make *evolutionary* rather than *revolutionary* changes to the organization (Caudle, 1995).

D. BUSINESS PROCESS RE-ENGINEERING (BPR)

BPR was introduced in 1990 rejecting continuous process improvement in favor of a more radical *start with a blank slate* approach. BPR is "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed" (Hammer and Champy, 1993). The basic premise is to take a process, identify the desired outcome, and build a new process "rejecting the conventional wisdom and perceived assumptions about the past" (Hammer and Champy, 1993). The result is a process that provides a remarkable performance improvement and may change the entire structure of the organization. BPR presents substantial risks because of the enormous change it endorses and the potential costs associated with implementing a radically different process.

E. BUSINESS PROCESS REDESIGN

By the mid 1990's this first wave of BPR softened after acknowledging that a combination of incremental and radical change was best (El Sawy, 2001). This middle ground territory is often referred to as business process redesign. Business process redesign usually focuses on removing non-value added activities and reducing the

number of personnel needed to perform the process either by leveraging technology, or integrating tasks (Caudle, 1995). A summary of some process improvement approaches is included in the Table 2.

Features	**Continuous Process Improvement**	**Business Process Redesign**	**Business Process Reengineering**
Philosophy	Improve what you do in a functional or sub-activity; Accepts status quo – current processes are what customers need	Accepts current process: Remove "hand off" activities of little value in an end-to-end examination	Focus on critical broken processes: Alter or replace basic approach to doing business in jobs, skills, structures, systems, culture
Timing	Part of a way of life to continuously improve; project results in short time frames	Done on a periodic basis; improvement may take a few months for simple efforts; 1 to 2 years if efforts are more complex	Used selectively; sub-processes deployment may take several months; full deployment across an entire complex process may take 2 to 5 years
Scope	Little emphasis on interrelationship of business processes in a business system; internal focus	Coverage of many sub-processes and "turf"; internal focus	Scope is entire process or major sub-processes that cover broad cross-functional areas; includes interfacing outside the organization
Leadership	Broad-based, bottom-up	Both bottom-up and top-down, more senior leadership needed	Management focused, top-down; significant senior management attention and time
Means	Generally, improvement work done by unit part time teams; use of quality tools	Improvement work often done by diversified task force or teams that cross functions	Improvement generally representing end-to-end activities; work facilitated by process sponsors and owners
Performance Gains	Incremental: Slightly increases (5-10%) performance	Moderately increases performance	Revolutionary: Greatly increases performance
Costs, Risks, Pain	Low: Resources generally easily handled within existing budgets and personnel allocations; small iterative investments; low-level effort offers few risks; pain of implementation is minimal	Low to Moderate: Resources may require shifting funds and personnel or adding more funds and personnel; risks increase somewhat as more activities are involved; implementation pain covers more activities	High: Resources require significant funding and dedicated personnel allocations; large, upfront investment; risks greatly increase given extensive process coverage; implementation pain is high

Table 2. Summary of Process Improvement Approaches. (Caudle, 1995).

F. SECOND WAVE BPR

In the mid 1990's the Internet and World Wide Web ushered in a new era of process improvement centered on the use of the Internet as an IT infrastructure capable of supporting new business models, or at least, fundamentally altering existing value chain structure from suppliers to distributors to resellers to end customers. Currently, another approach to business process improvement is taking shape, known as knowledge-based business transformation. In knowledge based business transformation, a large portion of the business process change is realized by changing the knowledge-creating capability of the business process and its environment (El Sawy, 2001). El Sawy refers to these trends, along with the trend toward time-based competition, in which business processes are redesigned for faster cycle times, as second wave business process reengineering.

G. REDESIGN OF THE CROSS-LEVELING PROCESS

The approach and process improvements realized as part of the conventional ammunition cross-leveling case study most closely resemble a business process redesign (intermediate approach). Several considerations drove the decision towards redesign and away from reengineering, including a relatively tight timeframe in which to complete the effort (6 months), a desire to contain the effort within a small core team, the geographic separation of team members, the desire to keep project risk fairly low, and the realities of a resource constrained environment.

The methodology employed for the ammunition cross-leveling process redesign is similar to that advocated by Omar El Sawy in *Redesigning Enterprise Processes for e-Business*. His approach is based on a review of available literature and from the practices of consulting companies with prominent BPR practices. The five typical phases in BPR are shown below.

The remainder of this chapter is devoted to briefly describing the first three phases and explaining how each was applied to the conventional ammunition cross-leveling process. Implementation is the subject of chapter five. The second half of Phase IV (organizational change) and Phase V are not covered in this case study, but offer potential for future research.

Phase I – Triggering and executive visioning

Phase II – Project mobilization

Phase III – Process Redesign

Phase IV – Implementation and organizational change

Phase V – Monitoring and maintaining

Figure 3. Five Typical Phases of BPR (El Sawy, 2001).

1. Phase I – Triggering and Executive Visioning

A significant process improvement effort, such as a redesign or reengineering, requires a catalyst or trigger. This can come in many forms including a performance problem, competitive repositioning, or pressure from a supply chain partner. Large changes, characteristic of reengineering are often driven largely by the vision of senior management as a result of some value creation opportunity or perceived need to cut costs. Smaller, incremental improvements are normally the result of suggestions made by employees or customers participating in the process. Often, these changes may be implemented without the direction or attention of top management.

With respect to the conventional ammunition cross-leveling process, the Air Force representative suggested that the cross-leveling process be moved to the web. She had personal knowledge of Air Force processes that were successfully migrated to the web. The Office of Executive Director for Conventional Ammunition (OEDCA) received her suggestion favorably and subsequently drafted a proposal that was forwarded to the Naval Postgraduate School for consideration. The proposal is included as Appendix B.

2. Phase II – Project Mobilization

During this stage, a project leader and core team is identified. The process or processes to be redesigned are selected and a BPR plan is developed. The plan should identify process boundaries, goals and contain a preliminary assessment of the Information Technology Infrastructure required. Budgets and timelines should be developed and agreed on.

On September 27, 2002 the authors' met with the OEDCA in Alexandria, Virginia. This began the mobilization phase of the conventional ammunition cross-leveling process. The core team consisted of the authors' and Diane Smith, Senior Logistics Management Specialist, OEDCA. During this one-day visit the authors were briefed on the *as-is* process and the vision for a redesigned process including a new information technology application capable of facilitating the exchange of information. The team roughed out a project plan that would serve as a framework for the process redesign.

3. Phase III – Process Redesign

Ideally, a BPR project brings together three design organizational elements: business strategy, business processes, and information systems. When information systems are not linked to processes and strategy, or when process is not closely aligned with the information infrastructure or does not advance the business strategy, the redesign is destined for disappointment.

The challenge for the Conventional Ammunition Cross-Leveling BPR team was becoming increasingly clear: How to align strategy, process, and information systems to best achieve the goals, while staying within the established constraints? The Process redesign stage is oriented around answering this question. In this stage process boundaries are defined, additional data is collected, key issues are identified, and process redesign goals further refined by developing corresponding measures. The next few paragraphs provide additional detail about each of these steps in Phase III – Process Redesign.

a. Identifying Process Boundaries

In his 1985 book, *Competitive Advantage*, Michael Porter introduced the idea of value chains to describe how processes are organized together, like links in a chain, each adding value. When the value chain extends beyond the enterprise (in a backward direction) to include supplier processes, it is commonly referred to as the supply chain. The value chain is also capable of extending beyond the enterprise in a forward direction to include the customers of customers. Efforts to better manage the supply chain in this direction are called Customer Relationship Management. Importantly, an increased opportunity for information exchange and the relative ease of

collaboration among diverse partners and systems, electronic commerce has been particulary successful in facilitating a longer and broader value chain. Figure 4 illustrates the value chain concept. Shown are three business units, each with a sequence of business processes (depicted as ovals) that are linked together with supplier and customer processes to form an industry value chain.

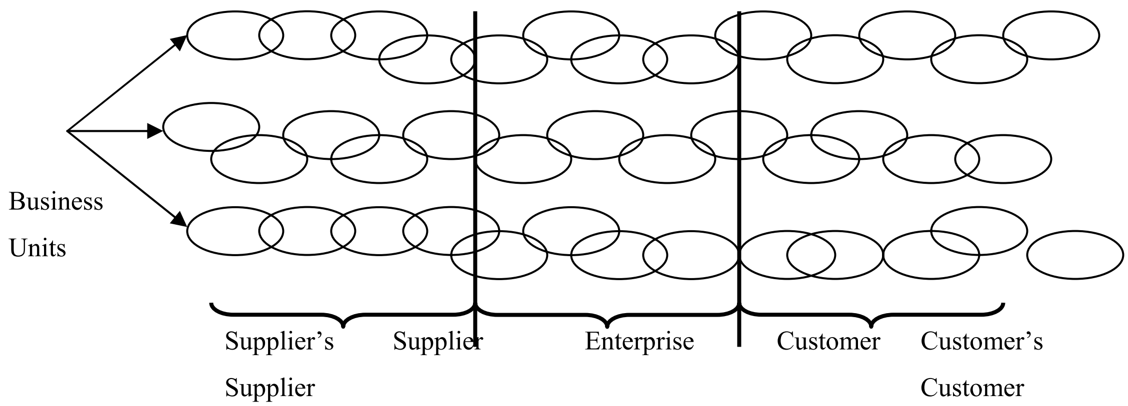


Figure 4. Alternative Levels of Analysis of Value Chain Boundaries.

In conducting a Business Process Redesign, process boundaries that signify the scope of the redesign effort must be established. The management challenges associated with an extended enterprise view involving numerous partners are significantly more complex than adopting the enterprise-centric view. There are several possible levels of analysis (El Sawy, 2001):

- An *enterprise-centric* view of supply chain processes that focuses mainly on business processes within an enterprise and how they interface with partners.
- An *extended-enterprise* view of supply chain processes that extend further to the customers' customers and the suppliers' suppliers.
- A *singular thread* view of supply chain processes at divisional levels that a given product family flows through.
- An *industry view* of supply chain processes that include multiple enterprises, multiple product lines, and multiple markets.

The process boundary map developed for the Conventional Ammunition Cross-Leveling redesign is shown in Figure 5.

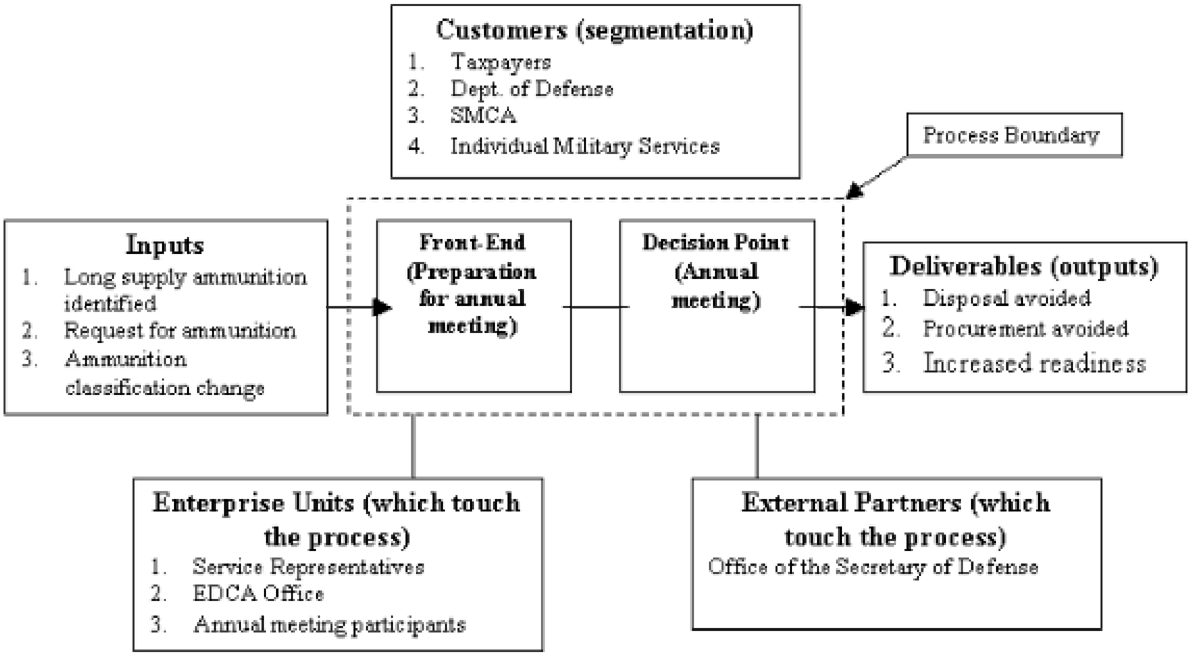


Figure 5. Process Boundary Map (El Sawy, 2001).

b. Data Collection

Collecting "as is" process data is important on many levels. It enables process analysis, diagnosis and provides a performance baseline to gauge improvement efforts. Data should come from the people involved in or familiar with the process, including customers, partners and stakeholders. It can also come from process-related documents such as reports, emails and meeting minutes. For a variety of reasons, some data will be unavailable. Teams should be careful not to spend an inordinate amount of time collecting data. How much data is enough? It depends on the level of accuracy required and, to some extent, on the type of improvement approach selected. For example, the reengineering approach advocated by Hammer and Champy requires little data collection because the "as is" process approach is largely discarded in favor of a radically different approach. As a minimum, enough data to construct a Process Flow Diagram (sometimes called Activity Decision Flow diagram) illustrating the basic process steps, including process inputs and outputs must be gathered. The "as is" process description and flow diagram for the Conventional Ammunition Cross-Leveling Process were presented in Chapter III.

c. Identifying Key Issues

Many managers are likely familiar with Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis and recognize it as a simple, but relatively powerful analytical tool for identifying key issues. Below is a SWOT analysis of the Conventional Ammunition Cross-Leveling Process.

STRENGTHS Strengths of the process as it exists now?	**WEAKNESSES** Weaknesses of the "as is" process?
1. Process is yielding good results 2. Single process manager concept provides clear accountability 3. Process incorporates technology that is available, familiar and easy to use (Microsoft Word, Excel, Outlook)	1. Process is fragmented and involves significant re-work. 2. Little visibility between service representatives with respect to specific inventory information (e.g., lot data) requires extensive communication and coordination 3. Process is oriented around a 1 year cycle time
OPPORTUNITIES How can the process generate new value?	**THREATS** What changes can cause process decay?
1. Process data may be used to improve inventory management 2. Process improvements can be used as a model for similar government processes	1. Failure to include a change management plan may result in backlash from process participants 2. Failure to plan for escalation in data management costs and expertise

Table 3. SWOT – Conventional Ammunition Cross Leveling Process.

d. Refine Process Redesign Goals

As the redesign team gains insight from their study of the "as is" process, it is important to review and refine established goals. The below table illustrates the goals, priorities and corresponding measures of success developed as part of the Conventional Ammunition Cross-Leveling Process.

Process Redesign Goals	Priority	Measures
1. Quickly identify ammunition cross-leveling opportunities	Medium	• Work time • Cycle time
2. Reduce email clutter and process re-work, including database re-work	High	• Number of emails sent/received • Work time • Employee satisfaction
3. Reduce probability of missed cross-leveling opportunity	Medium	• Number of cross-leveling transactions conducted • Dollar amount of ammunition cross-leveling transactions conducted

Table 4. Cross-Leveling Process: Goals, Priorities and Measures (El Sawy, 2001).

e. Process-Level Analysis

Thus far, analysis and diagnosis of the as-is process has remained at a relatively high-level. A more detailed analysis, focused at the process and activity (sub-process) level is required to construct design alternatives and estimate their performance impacts. There are numerous techniques and tools, including software, designed specifically to assist in process analysis and redesign. Almost every major management consulting firm and a growing number of Information Technology vendors have thriving BPR practice divisions (El Sawy, 2001). Similar to the process improvement approaches described earlier, there is no single best technique for process analysis and redesign. In the next segment, overviews of two different analytical techniques and their application to the conventional ammunition cross-leveling process are presented. We begin with the more traditional Activity Based Costing (ABC) approach and conclude with a lesser-known, more contemporary, Knowledge Value Added methodology.

H. ACTIVITY BASED COSTING

Activity Based Costing is an accounting and analytical tool designed to break down in detail the costs of all of an organization's activities. The assumption is that such detailed information will give managers the information they need—and have historically lacked—to make sound business decisions. This assumption is based on the idea that organizations perform activities to achieve a goal(s), that these activities cost money and that measuring the costs associated with the activities is a sensible approach to

understanding where the money goes (Saldarini, 2000). ABC differs from traditional cost accounting systems by pooling costs in activities instead of cost centers and by assigning those pooled costs to outputs based on cost drivers that are structurally different from traditional cost allocation bases (Cooper, 1992).

ABC is not without its disadvantages. "A lot of folks have tried to implement activity-based costing and failed," said Joe Donlan, an accounting expert with Arthur Andersen and part of a working group at the Consortium for Advanced Management-International that is developing an application to assist agencies and businesses with implementing ABC (Peckenpaugh, 2001). Implementing an ABC system is perhaps nowhere more difficult than within the Department of Defense. With more than $1 trillion in assets, a budget that amounts to about half the government's discretionary funding, and financial management systems that were never designed to capture the full cost of activities, DoD faces profound challenges in implementing ABC (McIntire Peters, 1999). Another disadvantage is that while ABC can reveal activity costs, ABC provides no insight into the value of these activities. At some point, activity costs and value must be calculated and compared in order to fully diagnose process performance. In effect, ABC only provides only half of the information needed.

1. Five Steps to ABC

The five steps of the Activity Based Costing process are summarized below (Housel and Bell, 2001).

Analyze Activities: Identify activities within processes; develop activity model (identify inputs, controls, outputs, and mechanisms); determine scope of project.

Gather Costs: Capture all relevant expenses that pertain to the selected processes and model.

Trace Costs to Activities: Costs identified in previous step are assigned to their respective activities from step 1; resulting costs for each activity will represent resources used by that activity to convert inputs to outputs.

Establish Output Measures: Determine output measure for each activity; determine activity output costs per unit of output.

Analyze Costs: Culmination of all measurements and calculations occurred thus far; analyze and review all data to identify candidates for improvement.

2. ABC Applied to Cross Leveling Process

The BPR team closely approximated the ABC steps outlined above to produce a working ABC model. The activities and corresponding outputs of the cross-leveling process as identified by the BPR team are presented in the below table.

Activity	Outputs
ANNUAL MEETING PREPARATION	
Build Stratification Report	Preliminary report identifying excess ammunition (by service)
Review/Approve Stratification Report	Report with fewer mistakes
Transmit Stratification Report to other service representatives	Shared understanding among service representatives regarding stratification desires
Request Lot Data	Email describing the need for further information about a specific lot of ammunition
Gather/Transmit Lot Data	Document/Email providing lot data information
Receive/Review/Decide on Lot Data	Increased understanding and decision about ammunition lot (condition, location, quantity)
Create Cross-leveling Request	Email requesting a service be placed on cross-leveling list.
Prepare/Transmit service cross-leveling report	Document/Email report showing excess service ammunition and corresponding cross leveling requests
Compile consolidated cross-leveling report	Consolidated cross leveling report listing all requests for each service
Transmit consolidated cross-leveling report	Email forwarding consolidated report to service representatives
CONDUCT ANNUAL MEETING	
Make Cross-leveling decisions	Consolidated cross-leveling report listing which service will get each lot of ammunition
Calculate cost savings	Report estimating the amount of money saved as a result of cross-leveling process

Table 5. Activities and Outputs for the Cross-Leveling Process.

Once the activities and corresponding outputs were identified, the BPR team allocated costs to each activity using time and salary data provided by those involved.[4] The below table summarizes the results.

[4] The "as is" cross-leveling process utilizes standard desktop computers and off-the-shelf Microsoft Office software. For simplicity, and because desktop PC's with MS Office software are standard in most organizations, these costs were not allocated to the various activities.

Activity	Activity Cost (% of total)	Activity Cost
Annual Meeting Preparation		
Build Stratification Report	20	$61,400.00
Review/Approve Stratification Report	5	$15,350.00
Transmit Stratification Report to other service representatives	2	$6,140.00
Request Lot Data	10	$30,700.00
Gather/Transmit Lot Data	12	$36,840.00
Receive/Review/Decide on Lot Data	10	$30,700.00
Create Cross-leveling Request	5	$15,350.00
Prepare/Transmit service cross-leveling report	10	$30,700.00
Compile consolidated cross-leveling report	5	$15,350.00
Transmit consolidated cross-leveling report	1	$3,070.00
Conduct Annual Meeting		
Make Cross-leveling decisions	15	$46,050.00
Calculate cost savings	5	$15,350.00
TOTAL	**100**	**$307,000.00**

Table 6. Activity Based Cost Allocation for Cross-Leveling Process.

The next task, estimating process benefit, is really not included as part of the ABC process. However, it is introduced now because at this point our team (and likely other teams engaged in similar efforts) began wondering earnestly how to estimate process benefits. In our case, a logical progression from lower level activities and outputs, to a more strategic view of goals, outcomes, and impacts resulted in a realization that the true benefit of the cross-leveling process can be measured by calculating cost avoidance. The next table illustrates this logical progression for the cross-leveling process.

Activity	Outputs	Goal	Outcome	Impact
Build Stratification Report	Preliminary report identifying excess ammunition (by service)	Improved Inventory Management	Prevent costs associated with unnecessary ammunition disposal and procurement	Increased Readiness
Review/Approve Stratification Report	Report with fewer mistakes			
Transmit Stratification Report to other service representatives	Shared understanding among service representatives regarding stratification intentions			
Request Lot Data	Email describing the need for further information about a specific lot of ammunition			
Gather/Transmit Lot Data	Document/Email providing lot data information			
Receive/Review/Decide on Lot Data	Increased understanding and decision about ammunition lot (condition, location, quantity)			
Create Cross-leveling Request	Email requesting a service be placed on cross-leveling list.			
Prepare/Transmit service cross-leveling report	Document/Email report showing excess service ammunition and corresponding cross leveling requests			
Compile consolidated cross-leveling report	Consolidated cross leveling report listing all requests for each service			
Transmit consolidated cross-leveling report	Email forwarding consolidated report to service representatives			
Make Cross-leveling decisions	Consolidated cross-leveling report listing which service will get each lot of ammunition			
Calculate cost savings	Report estimating the amount of money saved as a result of cross-leveling process			

Table 7. Program Logic Model.

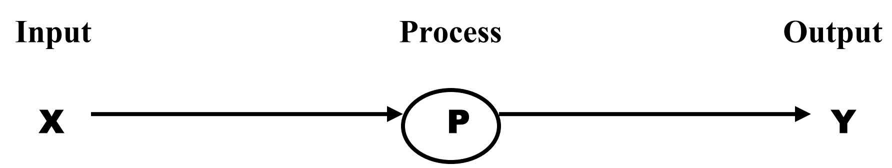
Specifically, ammunition disposal and procurement costs avoided as a result of the cross-leveling process are direct benefits and are easily stated in dollars. Moreover, these costs were already being tracked by OEDCA. In fiscal year 2002, OEDCA calculated $14.1 million dollars in disposal and procurement costs avoided as a direct result of the cross-leveling process. This analysis demonstrates the aggregate performance of the cross-leveling process is quite extraordinary; an investment of slightly more than $300,000 results in savings of more than $14 million! To gain additional

performance insight, especially at the activity level, the team turned to another technique - Knowledge Value Added.

I. KNOWLEDGE VALUE ADDED (KVA)

In *Measuring and Managing Knowledge*, Housel and Bell describe the paradigm shift from the Industrial Age to the Information Age and how managers and investors have come to understand knowledge as an asset that can be observed, measured and managed. Knowledge Value Added is a contemporary approach whereby knowledge utilized in processes is translated into numerical form, providing a methodology for allocating revenue and cost to a company's core processes based on the amount of change each produces (Housel and Bell, 2001). Figure 6 outlines the fundamental assumptions of KVA.

Underlying Model: Change, Knowledge, and Value are Proportionate



Fundamental Assumptions

1. If X=Y, no value has been added.
2. Value is proportionate to Change
3. Change can be measured by the amount of knowledge required to make the change.

Conclusion: Value is proportional to amount of knowledge required to make the change.

Figure 6. Fundamental Assumptions of KVA.
(Housel and Bell, 2001)

1. Return on Knowledge (ROK)

The ratio of process revenue to cost, ROK serves as the primary metric for the KVA process. Process learning time and the number of process instructions are often used to create a knowledge baseline so that revenue and cost can be allocated in proportion to the value added by that knowledge as well as the cost to use that knowledge (Housel and Bell, 2001). In short, ROK provides an estimate of the value added by an

organization's knowledge assets. This information can provide valuable insight into the health of core processes and prove very helpful to the redesign team.

2. KVA Applied to Cross Leveling Process

The activities, outputs, and cost information developed as part of the Activity Based Costing Process is reusable in the KVA process. However, recall that ABC itself is solely focused on cost and offers no insight into calculating process benefits. Fortunately, KVA provides a structured method for calculating Return on Knowledge, which incorporates both revenue (benefit) and cost information.

KVA begins with learning time estimations for each activity in the process. Learning time estimates were derived from process descriptions and discussions with process subject matter experts. The below table shows the activities, corresponding learning time estimates, along with a brief statement designed to encapsulate the complexity.

Process experts then estimated the number of times each activity is conducted annually. When multiplied by the learning time, we get the total amount of knowledge for each activity. The total amount of knowledge is converted to a percentage so that annual revenue can be distributed among the various activities. Annual revenue serves as the numerator for calculating the Return on Knowledge. Cost (from ABC) serves as the denominator in the ROK calculation. The KVA analysis and Return on Knowledge calculation for the cross-leveling process are summarized in Table 9.

Activity	Learning Time Rank (Diane) 1=Most, 12=Least	Relative Learning Time (Total = 100 days)	Learning Time Comments
Annual Meeting Preparation			
Build Stratification Report	1	20	Requires interface with individual Military Service Inventory Management System and knowledge of service ammunition requirements and processes.
Review/Approve Stratification Report	3	5	Management level knowledge. Need for identifying errors or higher-level issues involving readiness or politics.
Transmit Stratification Report to other service representatives	10	3	Basic knowledge of Microsoft Outlook. Ability to identify/communicate requirements.
Request Lot Data	9	3	Basic knowledge of Microsoft Outlook and ability to articulate specific lot information.
Gather/Transmit Lot Data	6	15	Requires interface with individual Military Service Inventory Management System and knowledge of lot data.
Receive/Review/Decide on Lot Data	2	15	Requires understanding of service needs and ability to read/interpret lot data information
Create Cross-leveling Request	12	2	Basic knowledge of Microsoft Outlook
Prepare/Transmit service cross-leveling report	7	5	Ability to synthesize service needs and processes to create a report. Knowledge of Microsoft Word.
Compile consolidated cross-leveling report	4	15	Ability to synthesize service needs and processes into a report. Knowledge of Microsoft Word.
Transmit consolidated cross-leveling report	11	2	Basic knowledge of Microsoft Outlook
Conduct Annual Meeting			
Make Cross-leveling decisions	5	8	Management level knowledge. Need to understand and apply established business rules. Ability to negotiate.
Calculate cost savings	8	7	Need to understand PPBES process, lot data information. Ability to use MS Excel.

Table 8. Cross-Leveling Activity Learning Time Estimates.

Activity	Number of process executions (per year)	Total amount of knowledge	Percentage of knowledge alloction	Annual revenue allocation	Annual costs	ROK
Annual Meeting Preparation						
Build Stratification Report	16	320	2.25%	$317,926	$61,400	517.79%
Review/Approve Stratification Report	16	80	0.56%	$79,481	$15,350	517.79%
Transmit Stratification Report to other service representatives	16	48	0.34%	$47,689	$6,140	776.69%
Request Lot Data	400	1200	8.46%	$1,192,221	$30,700	3883.46%
Gather/Transmit Lot Data	400	6000	42.28%	$5,961,105	$36,840	16181.07%
Receive/Review/Decide on Lot Data	400	6000	42.28%	$5,961,105	$30,700	19417.28%
Create Cross-leveling Request	50	100	0.70%	$99,352	$15,350	647.24%
Prepare/Transmit service cross-leveling report	4	20	0.14%	$19,870	$30,700	64.72%
Compile consolidated cross-leveling report	1	15	0.11%	$14,903	$15,350	97.09%
Transmit consolidated cross-leveling report	1	2	0.01%	$1,987	$3,070	64.72%
Conduct Annual Meeting						
Make Cross-leveling decisions	50	400	2.82%	$397,407	$46,050	862.99%
Calculate cost savings	1	7	0.05%	$6,955	$15,350	45.31%
Total		**14192**	**100%**	**$14,100,000**	**$307,000**	**4592.83%**

Table 9. Return on Knowledge Calculation – Cross-Leveling Process.

According to Housel and Bell, KVA analysis can identify areas where the organization can be more effective in exploiting its knowledge resources to generate outputs more effectively and efficiently. For example, the activity “Receive/Review/Decide on lot data” is the highest performing area while “Calculate cost savings” is the lowest. KVA methodology has been applied to more than 100 companies within the last 10 years and shows considerable promise as a tool for the information economy. Nevertheless, as Housel and Bell are quick to admit:

> No measurement methodology, however useful, can replace the creative insights, judgment and intuition of managers and investors. KVA is no exception to this rule and is best used as a decision support tool.

J. ABC VS KVA

The main difference between ABC and KVA is that each assumes a somewhat different focus, which is reflected in their methodologies. ABC is focused on the cost of activities; therefore, it is likely to lead to redesigning the most expensive activities. KVA is more broadly focused, incorporating both cost and revenue information to capture information about the value of the tasks. As a result, KVA is more likely to steer the user toward redesigning the tasks with the lowest ROK (Nomura and O'Connor, 2003).

For example, in the cross-leveling scenario previously described, ABC would focus on redesigning the most expensive tasks within the process boundary such as Gather/Transmit Lot Data ($36,840) and Receive/Review/Decided on Lot Data ($30,700). On the other hand, a KVA purist would argue these activities are performing well because of the relatively high ROK they provide (16,181% and 19,417%, respectively). Instead, a KVA approach would focus on redesigning the lowest ROK processes such as Prepare/Transmit service cross-leveling report (64.7%), Compile consolidated cross-leveling report (97.1%) and Transmit consolidated cross-leveling report (64.7%).

Interestingly, in the cross-leveling case, the tasks with the highest ROK are also the most expensive. According to ABC, these high-cost activities represent prime redesign targets. Unfortunately, ABC provides no analytical framework for determining *a priori* how reducing the cost of the task might affect its value. In contrast, KVA has no bias against expensive activities, provided their revenue is proportionately large.

Both KVA and ABC attempt to stratify processes into separate variables so decisions on process improvements are clearer and easier to make (Nomura and O'Connor, 2003). However, the results of either methodology should not lead to a blind course of action. Much of the decision-making rests on the ingenuity of the decision-maker herself. Both KVA and ABC are mere tools to provide a quantitative measurement for different processes. How those measurements are interpreted is left to the decision maker.

Regardless of the analytical methodology used, the end-state of the Process redesign phase is marked by the selection of a process best aligned with business strategy and information technology, and that meets or exceeds the established goals. Understanding how information technology is capable of enabling new ways of executing business processes quickly, flexibly and reliably is a critical skill for BPR teams.

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V. PROTOTYPE CONSTRUCTION AND RESULTS

A. OVERVIEW

This chapter describes the redesigned cross-leveling process and the construction of an information technology prototype built to support the redesigned process. The working prototype is a powerful tool for helping the sponsor envision the look and feel of the redesigned process and for establishing a proof of concept. The first half of the chapter provides a description of an overview of the tools used in building the prototype, provides a brief description of the 3-tier architecture on which it is based, and follows with a tour describing both the interface and functionality.

The second half of the chapter outlines the results of the redesign effort. A process flow diagram and KVA analysis are used to facilitate comparison of the original cross-leveling process with the redesigned process. Lastly, a more radical Business Process Reengineering approach is explored.

B. WEB APPLICATION PROTOTYPE DEVELOPMENT

In constructing the web application prototype, a variety of tools were used. The below table provides a summary of these tools and their purpose.

Tool Name	Purpose
Macromedia Dreamweaver UltraDev 4	Assist in creating webpages using HTML and ASP code
Microsoft Access 2000	Create back-end database to supply dynamic data to the webpage tool
Microsoft Excel 2000	Consolidate all Services' stratification reports into a single file that is imported to the Access database
Microsoft Internet Explorer 6.0	View web pages and test application
Microsoft Internet Information Server 5.0	Allow Macromedia Dreamweaver UltraDev 4 connection to server and http and active server page support of web pages

Table 10. Tools Used in Prototype Development.

1. The 3-Tier Architecture Overview

In a 3-tier architecture the database is separated from the presentation layer (user interface) by the business and data layers, enabling more scalable, robust solutions. Web applications are ideal for three-tier architecture, as the presentation layer is necessarily separate, and the business and data components can be divided up much like a client-server application" (Tanguay, 2002). Below is a graphical representation of a typical 3-tier architecture.

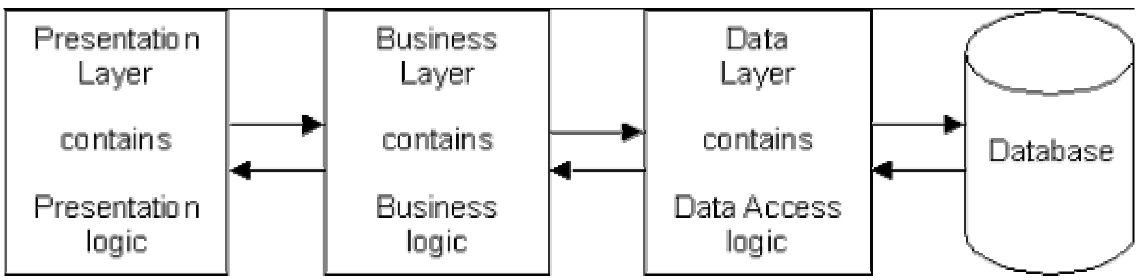

Figure 7. The 3-Tier Architecture.

Presentation and application logic are normally contained in the client machine, application and business logic in a middle tier application server, and data managed by database servers comprise the 3rd tier. Applications are typically controlled by user interface (web browser) in the client with substantial application processing taking place in the middle tier application server. The middle tier code typically drives 3rd tier data queries, updates, and transactions and implements shared business logic. Data manipulation performed by the application is typically done on object representations of 3rd tier data fetched through queries, or through data manipulation application program interfaces or Structured Query Language code that operates in the database server (Bretl et. al. 1998)

2. Creating a 3-Tier Architecture

Figure 7 contains the essential components for creating a 3-tier architecture that will serve as the foundation of a supporting infrastructure for the redesigned cross-leveling process. The next few sections provide a more detailed look at these building blocks and their application in the prototype. As the first component constructed and arguably the most important in the system, we begin with the database.

3. Database Design

The database created for the cross-leveling redesign follows the relational database model. In general, a database model shows what information is to be contained in a database, how the information will be used, and how the items in the database will be related to each other. The relational data model, developed by E.F. Codd in 1970, uses a table format to organize data and relations between data. In the relational model, a table is a collection of similar records with common attributes. Each row in the table represents a different record and each column in the table corresponds to a different attribute (field). Tables are linked together using keys. More than thirty years after it was invented, the relational model remains the most widely used type of data model.

While the database constructed for the re-designed cross-leveling prototype is relatively simple, consisting of only a few tables, it represents a substantial improvement over the database used in the current cross-leveling process. One of the main goals in creating the database was simplicity. With the information given, we strove to make a basic database with the necessary information to allow functionality of the website. As it stood, we only related two tables to one another in order to allow the combination of the quantity information and nomenclature to be visible through the website. ERMS, CRMS, PR and LongSupply columns were left bundled within the tblInventory table because there was no need to separate them into their own unique tables since they were logically linked to a specific DODIC and ServiceID combination. Tables for the usernames/passwords and requests were kept independent of anything else because their functions within the website were completely distinct from tblDodic_Nomenclature and tblInventory. Had we had the benefit of including lot information, we would have created a separate table and logically linked it to tblInventory with the same primary keys of DODIC and ServiceID. This would have allowed visibility between the two tables within the website application and would have eliminated update anomalies if distinct portions of each table had to be updated. The re-designed database schema is presented in the figure below.

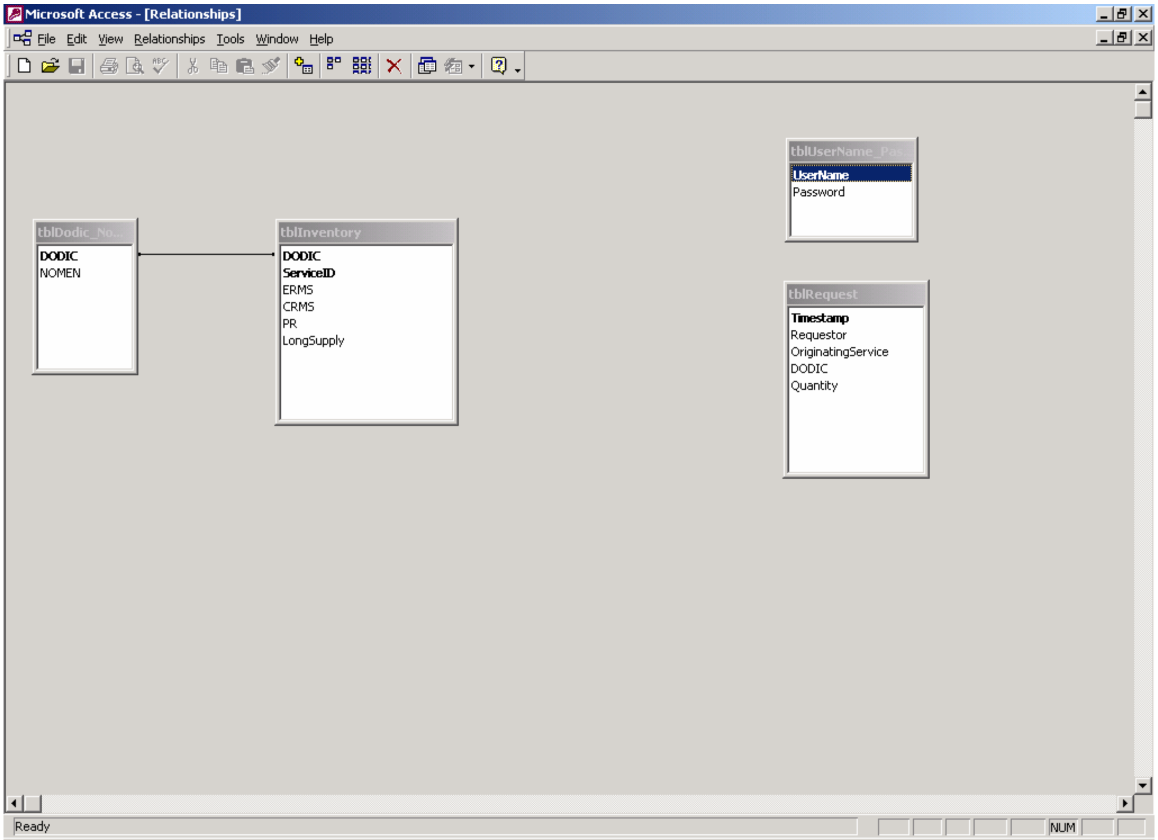

Figure 8. Database Schema.

Important considerations went into selecting the database for the prototype. In short, Microsoft Access 2000 was chosen because it is:

- Widely available
- Inexpensive
- Easy to Learn
- Suitable for small web applications (limited to 15 users)
- Easily scalable to SQL Server (when MS Access capacity is exceeded)

a. Connection to the Database

As implied by Figure 7, the database must be connected to the data layer on the server computer. This connection is accomplished using ActiveX Data Objects (ADO), a Microsoft technology, to access databases through the Open Database Connection (ODBC). Before making a successful connection, the database must be registered with a system data source name (DSN) in the ODBC applet located on the

server control panel. Once registered, the connection may be established using ADO code in the web page.[5]

b. Searching, Adding, Retrieving Data

Creating the database and making the connection to the server computer (and ultimately to the user interface) enables interactivity between the user and the database. SQL stands for Structured Query Language and it is the ANSI (American National Standards Institute) standard language for communicating with relational database management systems. SQL statements are used extensively in the prototype for searching, adding and retrieving data from the database. Standard SQL commands such as "Select", "Insert", "Update", "Delete", "Create", and "Drop" can be used to accomplish almost everything that one needs to do with a database.

C. PROTOTYPE CONSTRUCTION

The web pages contained within the prototype were created with HTML and active server page coding with the help of Macromedia Dreamweaver UltraDev 4. HTML coding was used to set the structure and layout of pages while ASP coding was used to implement dynamic data functionality between the web pages and database tables.

Users interface with the tool through a front-end web page from which they can navigate using hyperlinks. User authentication is accomplished through usernames and passwords, which are stored in the underlying database and are referenced through a user input form at the log in page. All pages within the site are protected with similar username/password authentication to prevent anybody from directly accessing a page without having first signed in through the log in page.

[5] An NPS student server administrator made the appropriate server configuration.

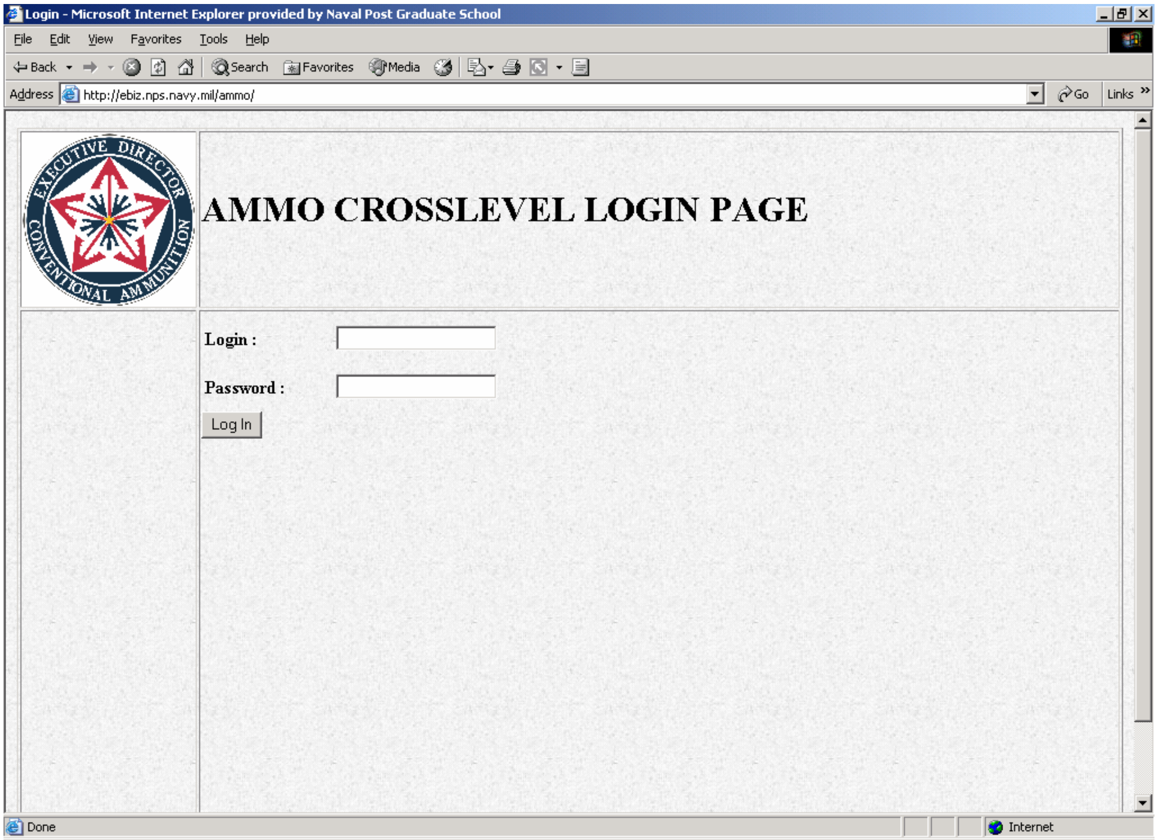

Figure 9. Login User Page.

Once admitted to the site, the users have several options including searching for ammunition, viewing posted lot data, submitting cross-leveling requests and viewing the cross-leveling report.

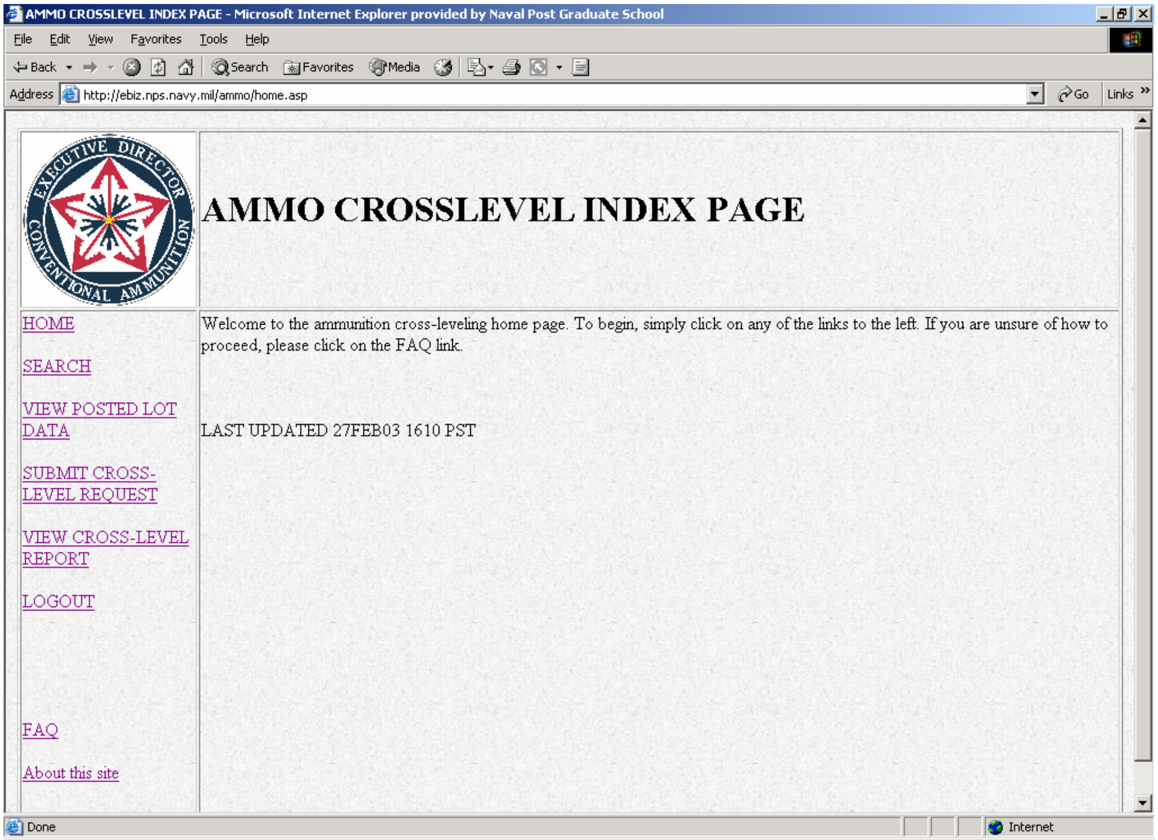

Figure 10. Home (Index) Page.

The most common event would most likely be searching for ammunition. By clicking the SEARCH link, users will be taken to a search page that gives them the opportunity to search by a specific DODIC or to simply search what all a particular Service has to offer for cross-leveling.

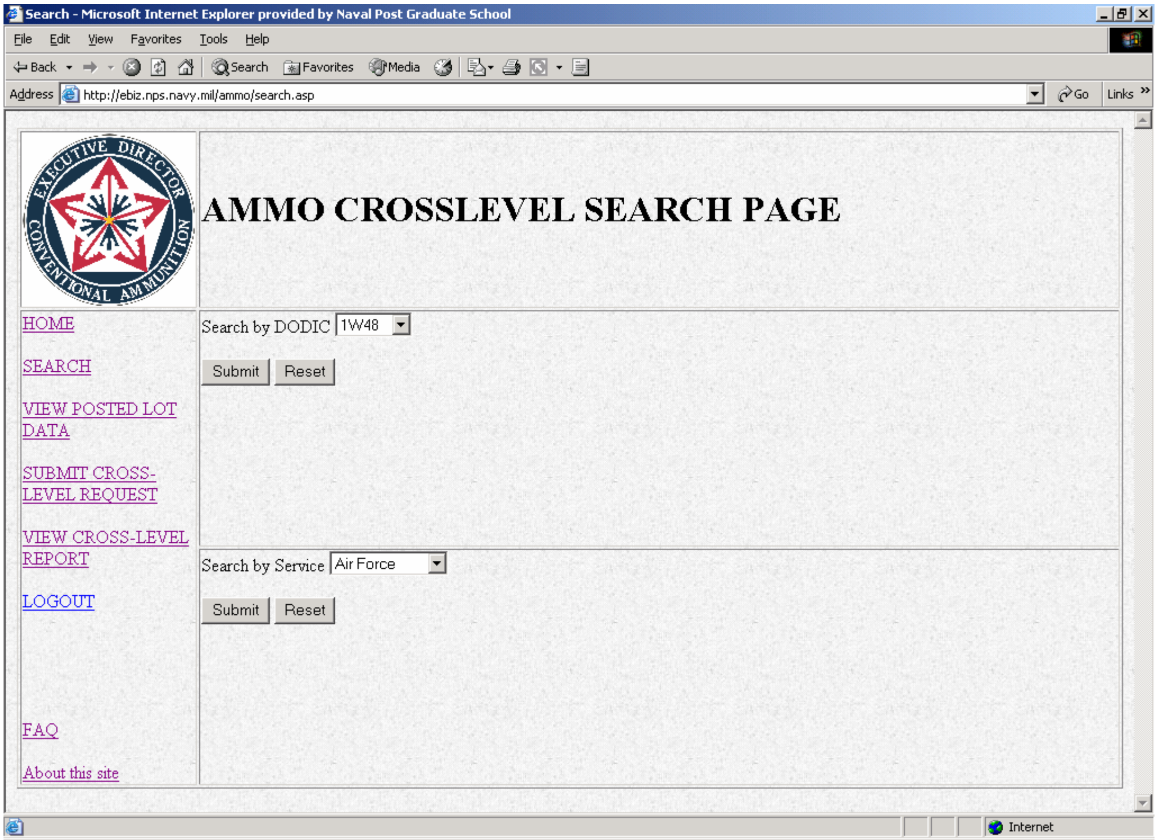

Figure 11. Search Page.

After submitting, the parameters of the search are sent via ASP code to the supporting database. The matching results are then set as parameters to the receiving results page. In the following figure, the results of a search for DODIC A068 are shown.

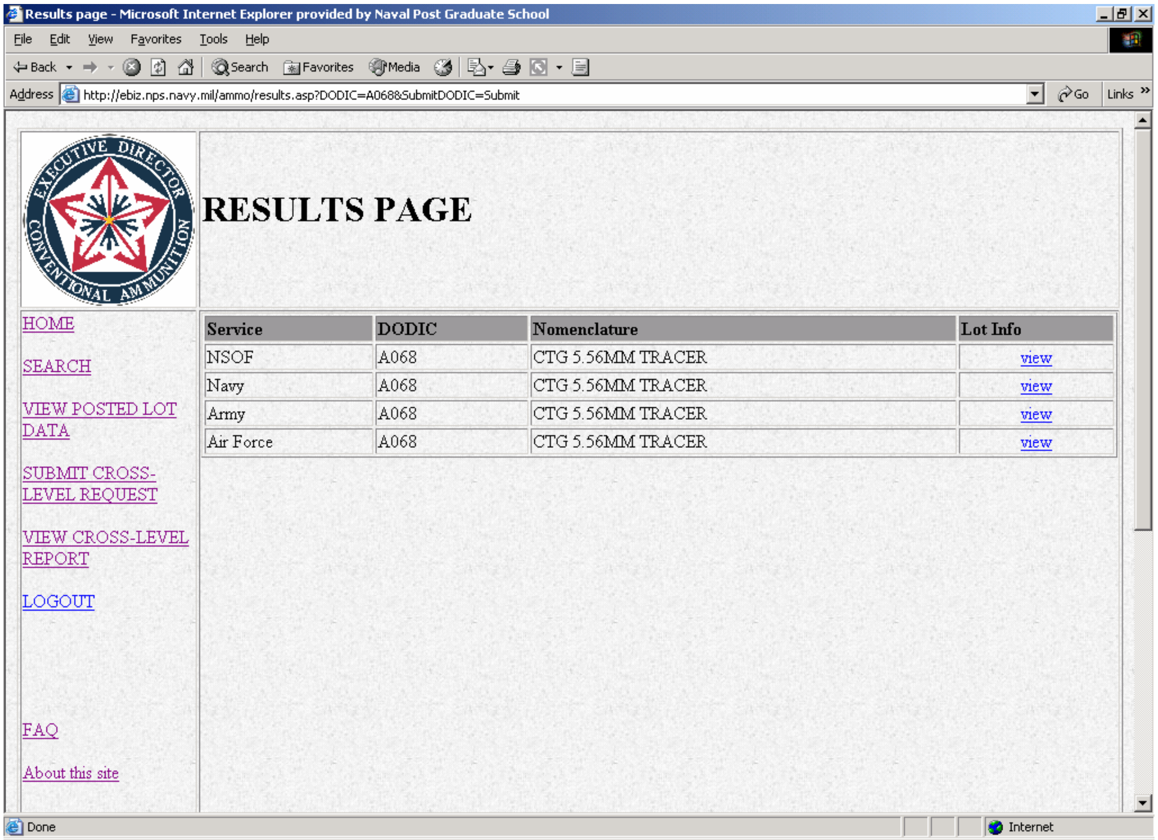

Figure 12. Results Page.

Users can then view more detailed information on the results by clicking the "view" link, which will take them to a detail page containing quantity information such as ERMS, CRMS, PR and Long Supply counts.

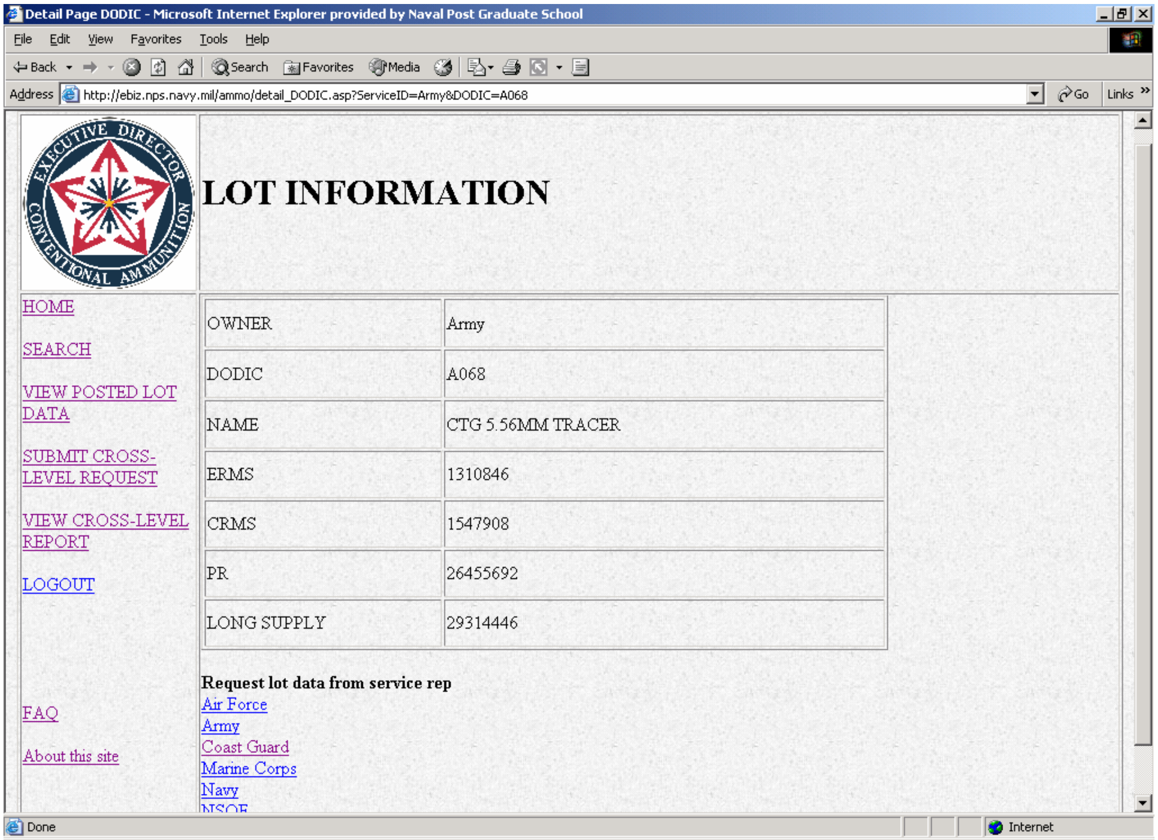

Figure 13. Lot Data Information Page.

As seen, additional information for the Army's holding of A068 was chosen and the resulting detail page was displayed. Information for this page is supplied by the previous page's parameters of ServiceID and DODIC that are sent via ASP code to the database, which returns corresponding quantity information for that specific record. If lot data on this holding is desired, the user can click on the lower links under "Request lot data from service rep" to bring up a standardized email message with pre-formatted subject and text.

If the lot data is already posted, the user can click on the VIEW POSTED LOT DATA link to be taken to another page containing active links to each Services' posting.

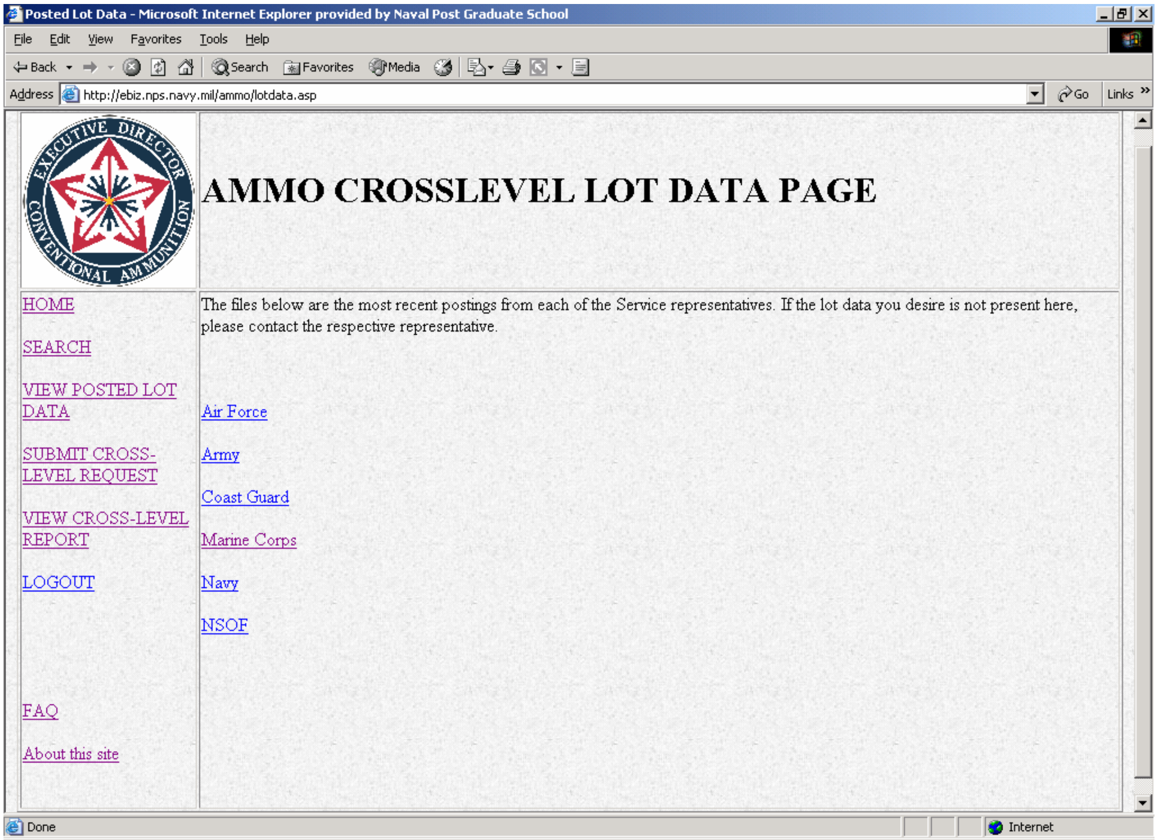

Figure 14. Lot Data Page.

By simply clicking on the above links, users can either view or download the underlying Excel spreadsheets onto their computers.

In order to make a cross-leveling request for ammunition, the user would click SUBMIT CROSS-LEVEL REQUEST after which a submit page will load. From here, users would choose the correct information for the fields via drop down menus, enter in the desired quantity and click the SUBMIT button. The parameters of the request will be saved in a table within the supporting database, which can be viewed by clicking on the VIEW CROSS-LEVEL REPORT link.

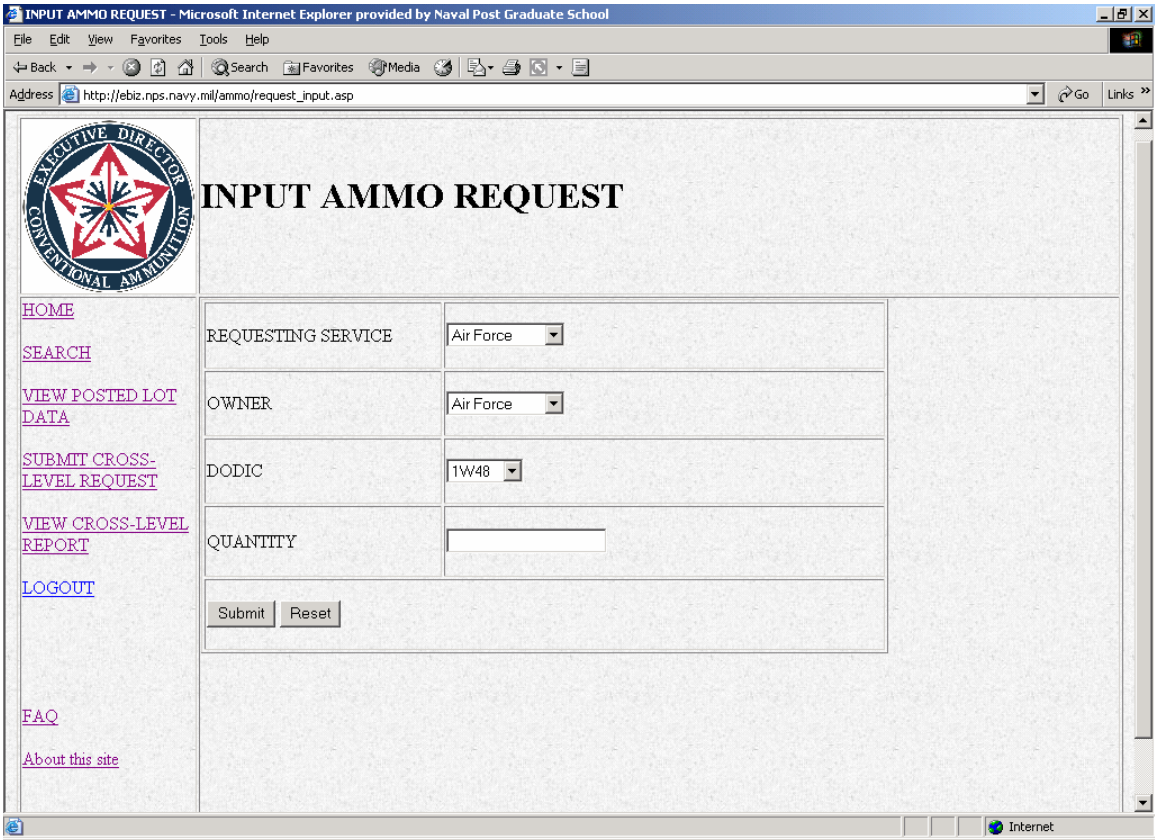

Figure 15. Input Ammunition Request.

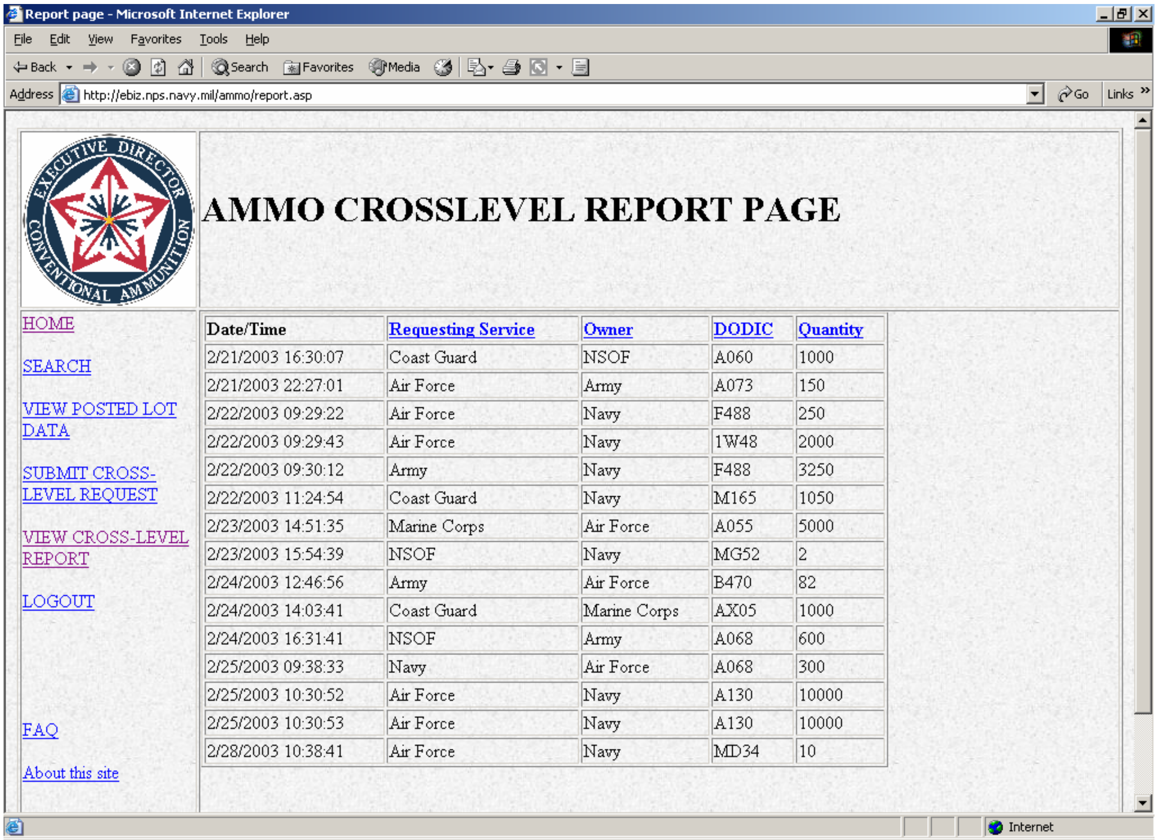

Figure 16. Cross-Leveling Report Page.

As shown, the cross-level report is shown and can be sorted by date/time, requesting service, owner, DODIC or quantity.

From this point, users can return to any of the previous pages to repeat searches, viewings or submissions. Each page contains the navigation links in the left column to allow the user to jump to any part of the website with a simple click of the mouse. To complete the session, users would click on the LOGOUT link and would close their browser.

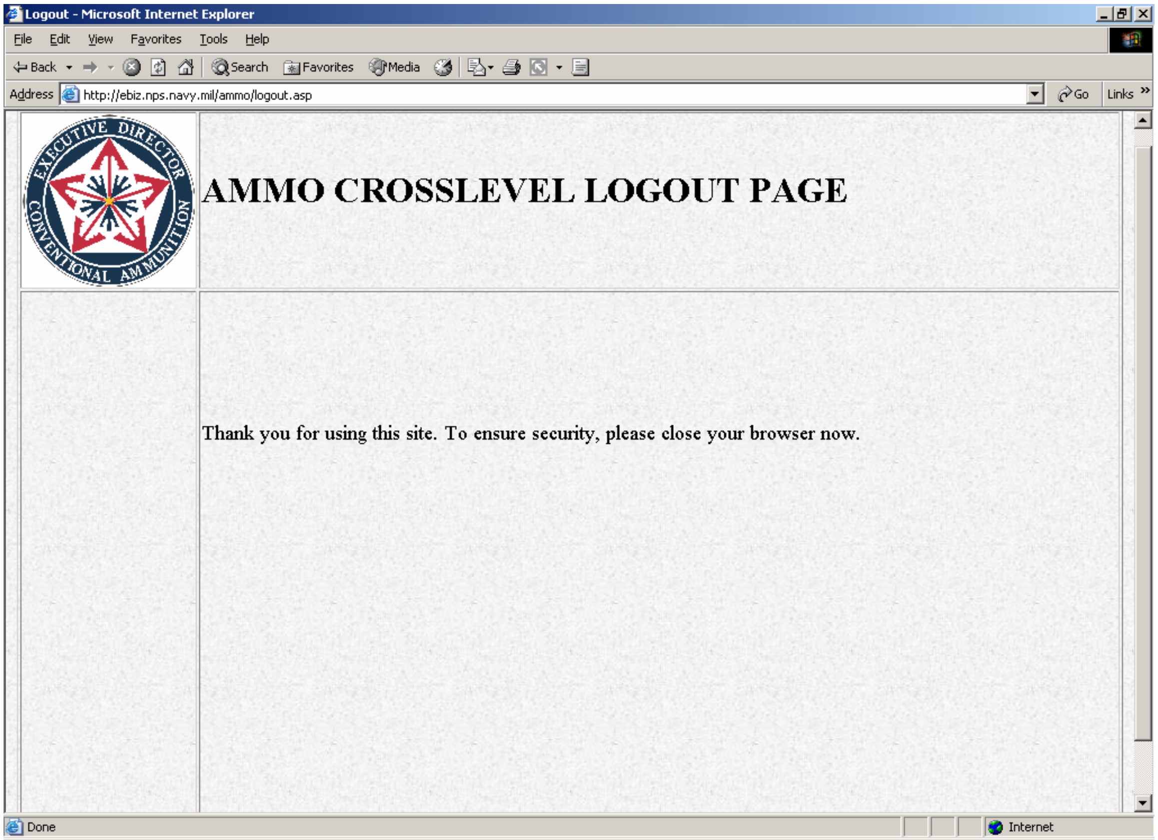

Figure 17. Logout User Page.

D. SUMMARY

This section briefly described the basic architecture, construction, functionality and user interfaces associated with the working prototype. It is intended to provide a visualization of exactly how the website can be used to support the cross-leveling process redesign efforts described in Chapter IV. Refinements and adjustments to the site are an important component of a final implementation plan. These issues are discussed further in the final chapter.

E. RE-DESIGNED CROSS-LEVELING PROCESS

The redesigned cross-leveling process can be compared with the existing cross-leveling process from many different perspectives. Inputs, activities, outputs and results are rather obvious comparisons. In addition, the knowledge required in performing an activity, the equipment and technology required to support the activity, and the amount and nature of organizational change effected by the new process are equally valid comparisons. Because the re-designed cross-leveling process is still conceptual, we use

activity flow models and tools such as KVA to describe and predict results. Actual implementation results will depend on a number of factors not included in the KVA analysis. Consequently, actual results may deviate substantially from the model.

1. Activity Flow Diagram

Below is an activity flow diagram representing the redesigned process.

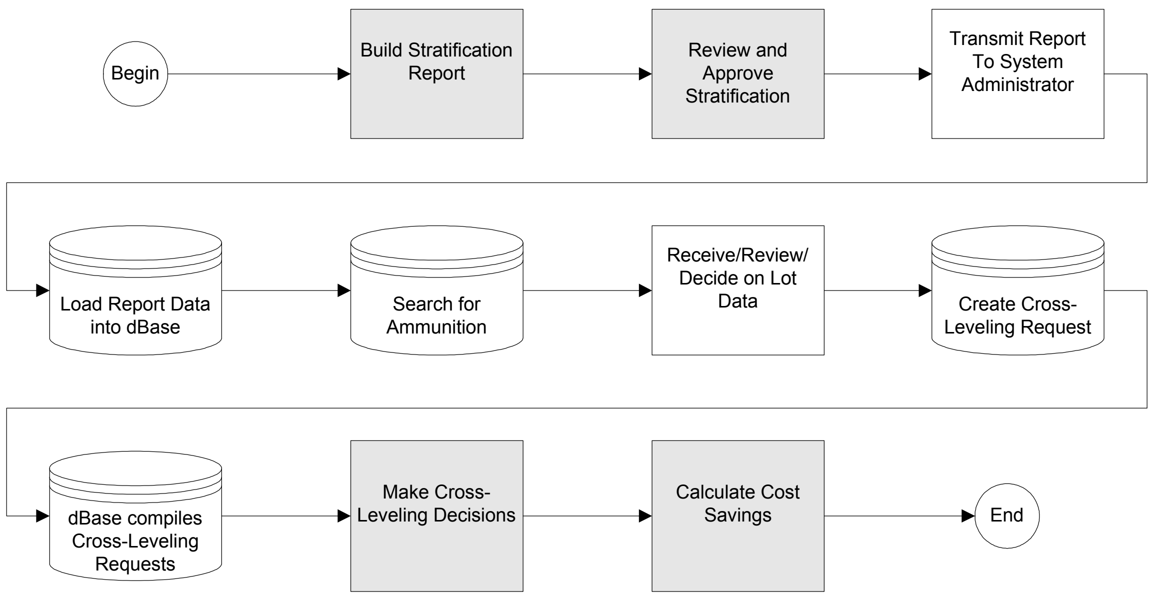

Figure 18. Activity Flow Diagram for the Redesigned Cross-Leveling Process.

a. Steps 1 and 2 – Build Stratification Report; Review and Approve Stratification Report

Steps 1 and 2 are the same as the existing process. In Figure 18, activities with little or no change from the "as-is" process are denoted using shading. Notice these activities are located near the beginning and end of the cross-leveling process sequence. This is largely due to the process boundary conditions established by the BPR team. In other words, the team elected to accept, without change, processes both downstream and upstream of the cross-leveling process. In a more radical re-design approach these boundary conditions can be expanded, creating more flexibility for changing these activities. In fact, this is illustrated in the radical re-design approach described later.

b. Step 3 – Transmit Report to System Administrator

The first substantive process change is at Step 3. In this step, the stratification report is transmitted to a system administrator for entry into the database.

Under the old process, the stratification report is transmitted to individual service representatives as an MS Excel spreadsheet email attachment.

c. Step 4 – Load Report into Database

Once received by the System Administrator, the stratification report information contained in the MS Excel spreadsheet is imported into the MS Access database. Importing MS Excel data into a pre-constructed MS Access database is a relatively simple task, especially when compared to consolidating data from multiple spreadsheets.

d. Step 5 – Search for Ammunition

Using the website, users can search for ammunition by Department of Defense Identification Code (DODIC) or Service. This represents an incremental improvement over the 'as-is' process.

e. Step 6 – Receive/Review/Decide on Lot Data

This step was clearly the most challenging for the re-design team. From a technical standpoint, there are distinct advantages to storing lot data in the database. If stored in the database, developers can provide users with convenient and easy interfaces for searching and viewing lot data. However, there is strong reluctance from the sponsor about including lot data in the database. The major challenge revolves around how to capture lot data in the cross-leveling database. To fully appreciate the sponsor's concern, it's worth reviewing a portion of the existing cross-leveling process. Lot information is extracted by service representatives using SQL query templates linked to service specific databases. Query results are output to MS Excel spreadsheets, which are sent via email to the requesting service. This process is graphically depicted in Figure 19 below.

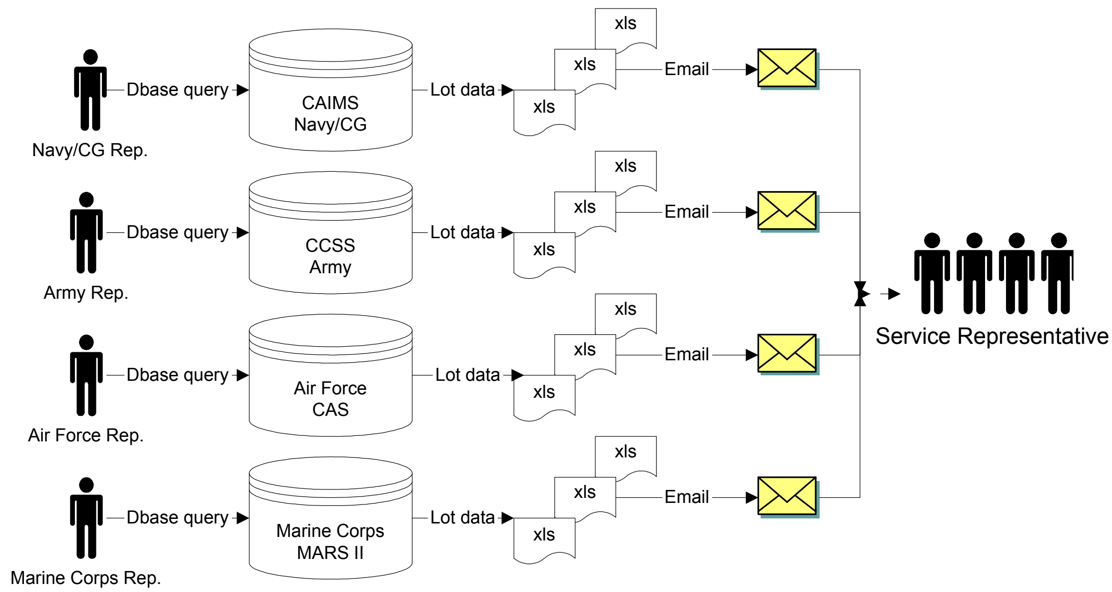

Figure 19. Transmitting Lot Data for the "As-Is" Cross-Leveling Process.

There are two practical alternatives for capturing lot data in the cross-leveling database. The preferred method is to capture the data from service specific source databases. This could be accomplished by creating a data warehouse or by directly linking to the source databases. However, the service specific databases are outside of the process boundaries and connecting to these databases would require substantial effort, including the need to gain appropriate permissions to include them in this effort.[6] The second option is to convert the MS Excel spreadsheets back into database form. However, lot information is quite dynamic and would require frequent imports of MS Excel data into the database. Even with frequent updates, it would be impossible to keep current using this process. Furthermore, service representatives are not trained in this task and do not have write privileges to the database (located on remote server). Consequently, in order to get lot data into the database the team was faced with a difficult decision – expand the process boundaries or implement a solution that has significant limitations process and technical drawbacks. The team decided to leave this activity unchanged while also building supporting infrastructure that will allow service representatives to view and update MS Excel lot data over the web.

[6] It's worth noting there is some evidence the service specific databases may already be connected to a data warehouse. If so, this might lessen the efforts required in connecting to lot data. Nevertheless, it remains sponsors preference to limit the current re-design effort to the established process boundaries and the issue was not pursued in depth.

f. Step 7 – Create Cross-Leveling Request

A web form provides service representatives the capability to quickly and easily create a cross-leveling request.

g. Step 8– Compile Cross-Leveling Request

When a service representative enters a cross-leveling request into the web form, it is submitted to the database. Once in the database, it may be viewed in several different ways depending on the users preferences. For example, the report can be sorted by DODIC, service or date.

h. Steps 9 and 10 – (No Change)

Steps 9 and 10 are performed at the annual cross-leveling meeting. The three-tier architecture is fully capable of supporting cross-leveling decisions in an on-line, transaction oriented way. For example, an approval block could easily be added to the cross-leveling request form. Someone with the appropriate access level could simply review and approve transactions on-line. This would substantially reduce the decision cycle-time and potentially eliminate the need for the annual meeting, thereby reducing process costs. While this is a viable option, it is best implemented in conjunction with resolving the lot data issues discussed in Step 6.

F. CALCULATING RETURN ON KNOWLEDGE

To facilitate comparison with the "as-is" process, the Knowledge Value Added (KVA) approach is used in determining the Return on Knowledge (ROK) associated with the redesigned process.

1. Costs

First, costs are estimated for each process. Results are summarized in the below table.

Activity	Activity Cost (%)	Activity Cost ($)
Annual Meeting Preparation		
Build Stratification Report	25	$53,750
Review/Approve Stratification Report	7	$15,050
Transmit Report to System Administrator	3	$6,450
Load Report into Database	5	$10,750
Search for Ammunition	5	$10,750
Receive/Review/Decide on Lot Data	20	$43,000
Create Cross-leveling Request	5	$10,750
Dbase compiles Cross-Leveling Report	3	$6,450
Conduct Annual Meeting		
Make Cross-leveling decisions	20	$43,000
Calculate cost savings	7	$15,050
Total	**100**	**$215,000**

Table 11. Redesigned Cross-Leveling Process Costs.

Total costs for the redesigned process are estimated at $215,0000. This represents a savings of $92,000 ($307,000 - $215,000) or approximately 30 percent.

2. Revenue

Since we do not have actual revenues, we again use costs avoided as a result of the cross-leveling process as a surrogate for revenue. Remember from chapter 4 that costs avoided come in two categories; one service no longer needs to purchase ammunition and another service no longer needs to dispose of ammunition in long supply. In the redesigned process, annual revenue is estimated to grow by approximately $290,000 or 20 percent.

a. Reducing Cognitive Overload

The revenue growth estimate is based on a hypothesis that a more efficient and capable process will yield more cross-leveling transactions. In other words, it is likely that the additional communication and coordination required by the "as-is" process results in missed cross-leveling opportunities. While not indisputable, we believe this assumption reasonable and supported by research. According to Kirsch, many of the consequences of cognitive overload, which includes information overload, multi-tasking, distraction and interruption, are well described in business studies (Kirsh, 2000). For example, a study of 1,313 junior, middle, and senior managers in the United States, United Kingdom, Australia, Hong Kong and Singapore revealed the following key findings (Waddington, 1996):

- Two thirds of managers report tension with work colleagues, and loss of job satisfaction because of stress associated with information overload.
- One third of managers suffer from ill health, as a direct consequence of stress associated with information overload. This figure increases to 43% among senior managers.
- Almost two thirds (62%) of managers testify their personal relationships suffer as a direct result of information overload.
- 43% of managers think important decisions are delayed, and the ability to make decisions is affected as a result of having too much information.
- 44% believe the cost of collating information exceeds its value to business.

While cognitive overload is a cruel component of the "information age" anything that enables employees easier access, storage and retrieval of information, or that reduces task complexity has the potential for increasing productivity. Or, in the case of the cross-leveling process, increasing the number of transactions per year.

b. Revenue Allocation

Revenue is allocated according to learning time estimates for the redesigned activities. Activities, associated learning time estimates, number of process executions, knowledge and revenues allocations for the redesigned process is shown in the below table.

Activity	Relative Learning Time	Number of process executions (per year)	Total amount of knowledge	Percentage of knowledge alloction	Annual revenue allocation
Annual Meeting Preparation					
Build Stratification Report	25	16	400	4.25%	$722,943
Review/Approve Stratification Report	15	16	240	2.55%	$433,766
Transmit Report to System Administrator	3	16	48	0.51%	$86,753
Load Report into Database	10	16	160	1.70%	$289,177
Search for Ammunition	5	400	2000	21.26%	$3,614,714
Receive/Review/Decide on Lot Data	15	400	6000	63.79%	$10,844,142
Create Cross-leveling Request	7	60	420	4.47%	$759,090
Dbase compiles Cross-Leveling Report	2	60	120	1.28%	$216,883
Conduct Annual Meeting					
Make Cross-leveling decisions	10	1	10	0.11%	$18,074
Calculate cost savings	8	1	8	0.09%	$14,459
Total	100		**9406**	**100%**	**$17,000,000**

Table 12. Allocation of Learning Time, Knowledge, and Revenue.

3. ROK for Redesigned Cross-Leveling Process

ROK is simply the ratio of revenue to costs. ROK for each activity is shown in the table below.

Activity	Annual revenue allocation	Annual costs	ROK
Annual Meeting Preparation			
Build Stratification Report	$722,943	$53,750	1345%
Review/Approve Stratification Report	$433,766	$15,050	2882%
Transmit Report to System Administrator	$86,753	$6,450	1345%
Load Report into Database	$289,177	$10,750	2690%
Search for Ammunition	$3,614,714	$10,750	33625%
Receive/Review/Decide on Lot Data	$10,844,142	$43,000	25219%
Create Cross-leveling Request	$759,090	$10,750	7061%
Dbase compiles Cross-Leveling Report	$216,883	$6,450	3363%
Conduct Annual Meeting			
Make Cross-leveling decisions	$18,074	$43,000	42%
Calculate cost savings	$14,459	$15,050	96%
Total	**$17,000,000**	**$215,000**	**7907%**

Table 13. Return on Knowledge– Redesigned Cross-Leveling Process.

As seen in the table, ROK for the redesigned process is 7907 percent, reflecting annual revenues of $17,000,000 and costs of $215,000. By comparison, the "as-is" process ROK equals 4592 percent (revenues of $14,100,000 and costs of $307,000). These results are quite good.

G. RE-ENGINEERED CROSS-LEVELING PROCESS

It is worth considering what a radically different cross-leveling process might look like, along with the potential rewards of such a solution. Chapter IV (Table 2) outlined process improvement efforts along a continuum. Of the various process improvement approaches, true Business Process Reengineering is the most radical. It has the largest scope, requires the most resources, involves senior management extensively, and offers the greatest opportunity for failure. However, it is the only method that offers

prospects for revolutionary performance gains. The re-engineered process is conducted in the same manner as the redesigned process but it introduces ideas and actions that may not be possible with the current set of constraints. That being said, it is included to show another option and to allow thinking "outside the box."

1. Activity Flow Diagram

Figure 20 below is an activity flow diagram representing the re-engineered process.

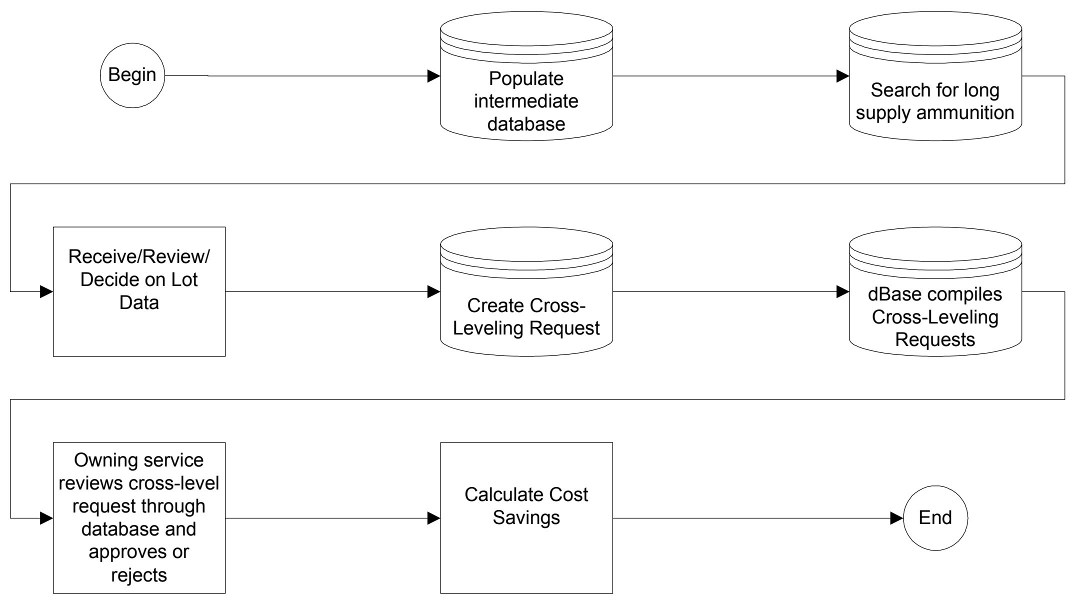

Figure 20. Activity Flow Diagram for the Re-Engineered Cross-Leveling Process.

a. Step 1 - Populate Intermediate Database

The boundaries of the incremental redesign effort were eliminated in order to allow some "out of the box" thinking on how to transfer ammunition data from a Service specific database to a single user. Although there currently isn't an intermediate database between the Service specific databases (e.g., CAIMS, CCSS, CAS and MARS II), Step 1 is introduced to show the potential of having such a repository. Our radical redesign calls for eliminating the stratification reports altogether. Instead of each representative preparing stratification reports to be mailed out and consolidated within the Office of the EDCA only to be mailed back out to each representative, the intermediate database would automatically run query commands to each Services' ammunition database to categorize the long supply ammunition from the rest.

b. Step 2 – Search for Long Supply Ammunition

Step 2 is similar to the incremental Step 5. However, though the front-end may be the same to the user, the means in which the data is supplied to the intermediate database is fundamentally different. Within the incremental redesign, a single person loads data after having consolidated all the Services' stratification reports. Within the radical redesign, the intermediate database resides between the Service specific databases and the users. Therefore, the data is loaded real-time from the Service specific databases. This alleviates an unfortunate person from consolidating all the stratification reports into a single database.

c. Step 3 – Receive/Review/Decide on Lot Data

Step 3 is very similar to Step 2 in the sense that the front end to the user is the same but the method by which lot data is supplied is fundamentally different. Due to constraints, the incremental redesign could not focus on the lot data situation. However, we did create a lot data repository through which users could view a Services' lot data. The radical redesign achieves the same user interface but supplies the lot data information directly from the Services' databases instead from a posted lot data page. We assume the intermediate database has visibility directly into each Services' database therefore a query from the user can be directly applied to the intermediate database, which would retrieve the lot information from the applicable service. This would alleviate the service representatives from posting lot data and would ensure that the lot data received is the most current. A graphical depiction of the lot data request is included below in Figure 21.

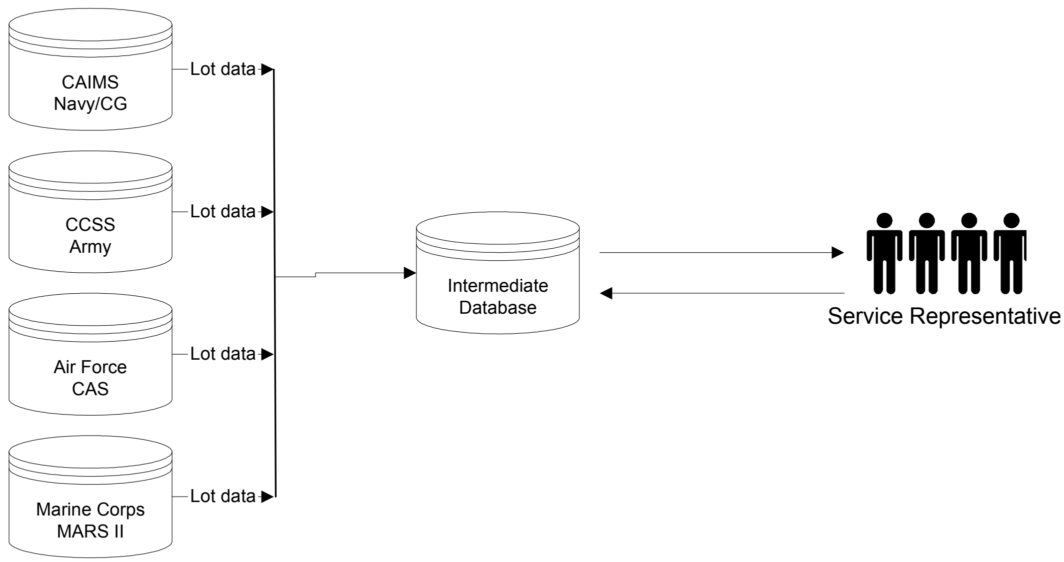

Figure 21. Transmitting Lot Data for the Re-Engineered Cross-Leveling Process.

d. Step 4, 5 and 6 – Create Cross-Leveling Request; dBase Compiles Cross-Leveling Request; Owning Service Reviews Cross-Leveling Request

Step 4 remains the same as in the incremental redesign in the fact that users post their requests to a cross-level request page. However, the main difference between the incremental and radical is the manner in which the process is handled. Incrementally, the request is viewed by the owning service and a decision is made. This decision is finalized at the annual cross-leveling meeting. On the other hand, the radical redesign calls for a process contained entirely within and through the Internet. The request is still submitted into the database and the review and decision process is captured in the database as well (Step 5). This type of request approval or rejection could be captured with checkboxes and comment blocks completed by the owning service (Step 6). This would speed up the actual cross-leveling process since the annual meeting would no longer be needed to finalize transfers. They could be completed all within a website and through a database.

e. Step 7 – Calculate Cost Savings

No change.

H. CALCULATING RETURN ON KNOWLEDGE (RE-ENGINEERED)

The KVA process for the re-engineering effort is conducted in the same manner as with the redesign effort, through costs and revenue.

1. Costs

Costs for each of the processes are listed below in Table 14.

Activity	Activity Cost (%)	Activity Cost ($)
Populate Intermediate Database	3.92	$5,000
Search for Long Supply Ammunition	8.43	$10,750
Receive/Review/Decide on Lot Data	33.71	$43,000
Create Cross-leveling Request	8.43	$10,750
Owning Service Reviews and Approves or Rejects Cross-Leveling Requests	33.71	$43,000
Calculate cost savings	11.8	$15,050
	100	**$127,550**

Table 14. Re-Engineered Cross-Leveling Costs.

2. Revenue

Likewise, revenue values are listed below in Table 15.

Activity	Relative Learning Time	Number of process executions (per year)	Total amount of knowledge	Percentage of knowledge allocation	Annual revenue allocation
Populate Intermediate Database	30	1	30	0.15%	$28,440
Search for Long Supply Ammunition	5	500	2500	12.48%	$2,370,260
Receive/Review/Decide on Lot Data	30	500	15000	74.85%	$14,221,560
Create Cross-leveling Request	5	100	500	2.50%	$474,050
Owning Service Reviews and Approves or Rejects Cross-Leveling Requests	20	100	2000	9.98%	$1,896,210
Calculate cost savings	10	1	10	0.05%	$9480
Total	100		**20040**	**100%**	**$19,000,000**

Table 15. Re-Engineered Allocation of Learning Time, Knowledge and Revenue.

3. ROK for Re-Engineered Cross-Leveling Process

Finally, ROK values are shown below in Table 16.

Activity	Annual revenue allocation	Annual costs	ROK
Populate Intermediate Database	$28,440	$5,000	57%
Search for Long Supply Ammunition	$2,370,260	$10,750	2205%
Receive/Review/Decide on Lot Data	$14,221,560	$43,000	3307%
Create Cross-leveling Request	$474,050	$10,750	441%
Owning Service Reviews and Approves or Rejects Cross-Leveling Requests	$1,896,210	$43,000	441%
Calculate cost savings	$9480	$15,050	6%
Total	**$19,000,000**	**$127,550**	**14,900%**

Table 16. Return on Knowledge – Re-Engineered Cross-Leveling Process.

As seen in Table 16, ROK for the re-engineered process skyrockets to 14,900%, reflecting annual revenues of $19,000,000 and costs of $127,550. When process boundaries are assumed non-existent, enabling the BPR team to focus on the entire value chain, it provides a liberating effect thus creating an opportunity for altering any or all of the processes, from production to disposal, by which ammunition is managed.

I. FURTHER THOUGHTS ON RE-ENGINEERING

Currently, the Army Material Command is engaged in a re-engineering effort called the Wholesale Logistics Management Program (WLMP). Our research indicates this multi-year program involves the implementation of an SAP[7] Enterprise Resource Planning (ERP) system. ERP systems, such as SAPs mySAP SRM offer comprehensive supply chain management and often enterprise-wide solutions.

For example, the mySAP SRM solution:

> …Covers the full supply cycle, from strategic sourcing to operational procurement and supplier enablement while leveraging consolidated content and master data. With mySAP SRM, companies can qualify new suppliers and manage contracts, automate cross-company processes with all suppliers, and enable suppliers to participate in e-procurement and sourcing easily and cost-effectively. Companies can gain complete visibility of purchasing activities across multiple business units and heterogeneous systems, allowing them to leverage global spend analysis for implementing improved procurement and sourcing strategies (SAP.com, 2003).

According to the Army:

> The WLMP is a key component in the Army's major transformation to become more responsive, deployable, agile, versatile, lethal, survivable, and sustainable. This transition requires the Army to exploit technology, eliminate activities that do not add value, and develop processes that result in sound and timely decision making. The only way for the Army to meet this challenge is to find a way to capitalize on the dramatic business process and technological advances that are occurring in the commercial world. The WLMP solution will provide an integrated logistics management capability that enables total asset visibility; velocity management; enhanced decision support; a collaborative planning environment; a single, actionable source of data; improved forecasting accuracy; and real-time, easy access to enterprise wide information.

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[7] Headquartered in Walldorf, Germany, SAP is the world's largest inter-enterprise software company, and the world's third-largest independent software supplier.

1. Summary

Both the WLMP and the more incremental approach implemented as part of the cross-leveling case study are consistent with the E-Government strategy outlined in Chapter II. While they may appear inconsistent, this perception likely stems from their vast differences in scope. In reality, the author's believe these efforts can be mutually supportive. The more incremental approach can provide the organization with valuable experience and revealing insights into important sub-processes that may prove beneficial in larger reengineering efforts. Conversely, radical reengineering can provide solid long-range solutions to deep-seated and often enterprise-wide issues that are beyond the scope of less dramatic change efforts. Savvy managers may use smaller efforts to gain the critical attention and support required of upper management for radical reengineering.

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VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSION

We began with an overview of electronic commerce and electronic government and outlined the federal governments' management strategy for using technology to improve government services. Comparisons between the government and commercial sector revealed the extent to which the commercial sector quickly embraced the Internet and modern communication technology as a competitive weapon. Conversely, using the Internet to improve government services within the federal bureaucracy is taking substantially more time to gain momentum. Many electronic government barriers are deep-seated and have little to do with technology and more to do with firmly entrenched processes and a reluctance to change. Overcoming this resistance will require the full cooperation and understanding of government managers about the role of electronic government and how it can be effectively implemented within a resource constrained environment. The case study of the Conventional Ammunition Cross-leveling process provides a template for managers on how electronic government projects with similar characteristics can be implemented using proven methods of business process redesign and the collaboration of government program managers and information technologists.

Using an activity flow diagram and process descriptions, we described the existing cross-leveling process in chapter three and highlighted perceived strengths and weaknesses of the as-is process. Notably, in fiscal year 2002, the cross-leveling process yielded about $14 million in benefits (savings) at an estimated process cost of about $300,000. Despite these impressive results, the existing process did not take full advantage of contemporaneous information technology, resulting in process inefficiencies, re-work, and potentially missed opportunities.

In chapter four, a process redesign methodology based on best practices was introduced and applied to the conventional ammunition cross-leveling process. Activity Based Costing and Knowledge Value Added were presented as analytical measurement techniques for quantifying process improvements. Using KVA analysis, significant process improvement increases were realized in both the redesigned and reengineered

approaches. Moreover, analysis shows that process costs can be reduced from $307,000 to $215,000 and benefits increased from approximately $14 million to $17 million by implementing the redesigned cross-leveling process.

Some important principles for consideration during the process redesign phase are summarized below:

- As pointed out by Davenport, it is necessary to understand the current process because without such an understanding, there is no way to realize the benefits of the redesigned or re-engineered system.
- It is often useful to quantify the existing and improved processes through the use of ABC, KVA or both. They have slightly different focuses and the correct choice will depend on individual case circumstances. Ultimately, it is up to the manager how she decides to interpret the results.
- Explore the opportunities available and the risks inherent to both redesigned and re-engineered systems. Carefully deliberate the approach and select an approach best suited to the specific circumstances of the organization.
- Incorporate a prototype application into the redesign phase to minimize implementation risk.

The underlying technology necessary for implementing the redesigned cross-leveling process was introduced in chapter five. Specifically, a three-tier architecture serves as the foundation for a dynamic web site prototype created to help identify and process cross-leveling transactions. The three-tier architecture is ideally suited for searching, viewing, adding, modifying and deleting information stored in a database and viewed through the Internet/Intranet.

Likewise, a working prototype is a useful tool in almost any iterative development process, by permitting subject matter experts and project stakeholders to more easily visualize the redesigned process. This visualization facilitates better dialogue and refinement of project requirements and provides the project sponsor with an excellent tool for gaining executive-level support and funding.

1. Strengths and Weaknesses of the Case Study Approach

The case study methodology is not without weakness. It offers little opportunity to control for 3rd variables that may enter into the problem space. Secondly, a single case is somewhat limiting, because, by definition, we are dealing with specific circumstances. The net effect is that one must be careful when translating the results of a

single case to those of other cases (Van Evera, 1997). However, case studies provide a unique opportunity to examine and apply theories to real world problems and conditions. Such an opportunity is central to our thesis of learning how to better implement e-government.

2. Extrapolating Results

Notwithstanding the above, we believe the circumstances of this case are somewhat typical of many government processes. Specifically, there is a reasonably good understanding of the existing process and its performance characteristics, a genuine desire for change by at least some of the process workers and upper managers, and at least the perception of limited resources (time, money, expertise) for any process improvement effort.

Furthermore, the business process improvement methodologies employed in the cross-leveling case are extensible to almost any electronic government project. El Sawy's *Redesigning Enterprise Processes for e-Business* provided the foundation for analyzing and redesigning the cross-leveling process. Really, this approach is a collection of best practices and principles that have been used successfully in scores of companies including LL Bean and Federal Express (El Sawy, 2001). Similarly, ABC was popularized by Peter Drucker in the 1950's and, since then, has been used extensively by companies and government alike (Gray, 2000). While much newer and still revolutionary, KVA has been used in more than 100 companies to gain insight into how knowledge assets are deployed throughout an organization's core processes (Housel and Bell, 2001). Lastly, the three-tier (or n-tier) architecture is a commercial best practice capable of serving as the foundation for a wide variety of electronic government applications, especially those that require search, update and display functions (Schneider, 2002). Our research shows that this can benefit not only inventory exchange processes but also any processes that involve the exchanging of information.

B. RECOMMENDATIONS

The following recommendations are intended for consideration of the Office of Executive Director for Conventional Ammunition. As mentioned earlier, the incremental redesign approach appears more suited to EDCA's goals and culture and should form the basis of a solution. However, the redesigned process and associated prototype should be

viewed as part of an iterative development process. In other words, they serve as the first draft in an effort to more completely define the requirements and goals of any cross-leveling redesign. Despite this caveat, several opportunities appear sensible and bear further consideration by EDCA:

- **Expanding the web interface** Allow users more complete access to ammunition information using the website. Using the web interface for some activities (e.g., DODIC search) while not using it for others (e.g., view lot data information) may prove awkward and reduce efficiency.
- **Incorporating lot data into database** Recommend further examining the best methods for including lot data in a database accessible over the web.

Implementation and Organizational Transformation and *Monitoring and Maintaining* comprise the last two stages of an effective process redesign methodology. Although mentioned in chapter four, these stages are largely beyond the scope of this thesis, which effectively terminated at the conclusion of the process redesign stage. The Implementation and Organization Transformation stage:

> "…involves introducing and instituting the new process with its accompanying organizational design changes, training people (sometimes firing them) and possibly reskilling them and dealing with the political and human problems that can occur whenever a large organizational change is made" (El Sawy, 2001).

Complex organizational change is inherently difficult to manage. Creating new and more effective cross-leveling processes is one challenge. Effectively implementing these changes is quite another. EDCA should create a comprehensive change management plan prior to implementing the redesigned cross-leveling process.

Finally, processes must be monitored and maintained if they are to continue to perform at their full potential. EDCA should adopt a system of continuous process improvement to ensure the prolonged vitality of the redesigned cross-leveling process.

C. FUTURE RESEARCH

The following areas may benefit from further study:

- The working prototype was not fully tested or evaluated by process subject matter experts. A field test of the prototype is beneficial for evaluating its suitability, validity, and reliability.

- Measure and compare actual results for the redesigned process against estimated values. Any differences could be analyzed and compared to help determine the cause.
- Further analyze service-specific ammunition databases and use them to develop a data warehouse (or data mart) that facilitates the cross-leveling process. With access to the data warehouse, service representatives would no longer need to post lot data or compile stratification reports. Instead, this information would be easily viewed by connecting the data warehouse with the web site in a three-tier architecture.

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APPENDIX A. GLOSSARY OF TERMS

3-tier architecture – an architecture used in web applications that separates the Presentation, Business Logic and Data Layers from one another in efforts to optimize the performance and scalability of a system.

Activity based costing – method of analyzing a process by measuring the cost and performance of individual activities.

Activity decision flow diagram (see also: process flow diagram) – the graphical representation of the activities within a process connected in a logical order to show the progression of the process itself.

Business process – set of inputs, behaviors and outputs of a system.

Business Process Re-design - focuses on removing non-value added activities and reducing the number of personnel needed to perform the process either by leveraging technology or integrating tasks.

Business Process Re-engineering - the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed.

Chief Information Officer – person in an enterprise responsible for the information technology and computer systems that support enterprise goals.

Conventional ammunition - non-nuclear ammunition covering a wide variety of items from 5.56-mm. cartridges to 2,000-pound bombs. The majority of ammunition items have four major components--a metal body, an explosive, a propellant, and a fuze.

Cross-leveling – the process for transferring long supply ammunition among Armed services.

Customer Relationship Management – a process by which an enterprise tracks and supports the needs of its customers by allowing visibility of customer information among all employees in the enterprise and also by data mining to target specific needs of customers.

Database schema – visual representation of how database entities are linked together

Knowledge Value Added – methodology designed to estimate the value of knowledge deployed throughout a company's core processes.

Long supply ammunition – the quantity of ammunition available for cross-leveling among Armed Services.

Process flow diagram (see also: activity decision flow diagram) – the graphical representation of the activities within a process connected in a logical order to show the progression of the process itself.

Productivity paradox – the argument that productivity measures do not seem to show any impact from new computer and information technologies.

Relational database model - shows what information is to be contained in a database, how the information will be used, and how the items in the database will be related to each other by using tables, rows and identification keys.

Return on Knowledge – a ration measure of Knowledge Value Added determined by dividing the percentage of revenue allocated to the amount of knowledge required to obtain the outputs of a given process (numerator) by the cost of execute the process knowledge (denominator).

Stratification report – annual report prepared by each Armed Service detailing the conventional ammunition available for cross-leveling through the Office of the Executive Director for Conventional Ammunition.

Value chain – high-level model of how businesses receive raw materials as input, add value to the raw materials through primary and support processes, and sell finished products to customers.

APPENDIX B. EDCA PROJECT PROPOSAL

PROPOSAL FOR MASTER'S THESIS PROJECT

A. NEED: A web-based, heuristic computer tool needs to be developed to assist the Military Services and the U.S. Coast Guard in conduct of cross leveling of Class V conventional ammunition. A Functional Requirements Document, a Detailed Design Description, and a User's Manual must support this tool.

B. BACKGROUND:

1. Eight Military Service, U.S. Coast Guard, or DoD offices are required to share information to accomplish the cross leveling mission for Class V conventional ammunition. Cross leveling allows for free exchange of conventional ammunition among Services so that requirements can be met and planned procurements canceled.

2. A web-based, computer tool needs to be developed to assist in conduct of cross leveling of Class V conventional ammunition. This tool would provide information for users from each of the Military Services to use when listing their available long supply assets and for providing logistics supply details to assist in determining acceptability of the offered material. Additionally, Planning, Programming, and Budgeting System (PPBS) information from the Single Manager for Conventional Ammunition (SMCA) would be listed so that the offered items can be compared to the list of SMCA-assigned material under procurement. This would be used to identify potential and actual cost avoidances achieved through cross leveling of conventional ammunition.

C. CURRENT PROCESS:

1. The Service-owned potentially-available supply data and PPBS information are received in six Excel spreadsheets that are then input and manipulated through a single Access database built to support this effort each year. The output is converted to a rich text format file (.rtf) that can be read by word processor programs such as Microsoft Office Word. The .rtf file is then emailed to all parties where it is painstakingly reviewed in detail. Lot level supply information is then requested by multiple parties and sent via email. An annual meeting is held where all parties

discuss the cross leveling. Decisions are made, descriptive notes are prepared on the potential transfers, and the decisions and notes are incorporated into the .rtf file.

2. Meeting minutes are prepared that summarize the decisions and constitute an after action report.

3. As the cross-Service, cross-leveling transfers occur during the fiscal year, quarterly reports are submitted to one office where the information is tallied to determine the actual SMCA-assigned cost avoidances achieved. Those items reported as being cross-leveled but not on the SMCA PPBS procurement-planning document are tallied as a side issue for effectiveness of the process.

4. The next year's meeting reviews the results of the previous year's cross-leveling efforts and uses new updated information to conduct that year's iteration of the process.

5. Each year new data is uploaded for the process. The previous year's data must be retained for historical records. It is only used again as a guide to build files the next time and in case a requirement to research details (such as an audit) occurs.

6. The current process is complex and time consuming. Information is not easily visible during the review process leading up to the annual meeting.

7. When lot data information is requested by one Service, the information is passed by email shortly after the request is made. Another Service might request the same information at a later date and a second email must be prepared and sent.

8. Nothing alerts the participants to indicate an email has been sent or should be sent so communications sometimes fail.

9. The Service representatives cannot tell when the first priority taker for a cross-leveled item has chosen not to accept the material. This causes a time delay, procurement to fill the requirement could already be initiated, and thus cross-leveling to the second Service does not actually result in a cost avoidance.

10. The Access database must be rebuilt each year to incorporate the new files of information. Building this database takes at least one man-week of labor. Formatting

the output to send out for review requires another day or two. Tallying up the results and adding in the notes from the meeting requires at least another week of labor.

D. WHAT TOOL MUST DO:

1. This tool would allow for sharing of information among authorized users and for preparation of the data that is currently in the Access database each year. This tool would be used by a limited number of personnel at approximately ten locations. The information contained in the tool would be unclassified, but time and procurement sensitive. For this reason password protection would be required.

2. Because this tool would be an annual device used in conjunction with preparation of the budget submissions, it should not be tied directly to inventory management systems. It should take data from the "single point in time" used by the Services for PPBS planning purposes. This information can be provided in Excel spreadsheets, but Services do not necessarily use the same version of Excel.

3. Tool must accept input from Excel spreadsheets as primary input method with typed in entries as an occasional method. Tool must also provide output in Excel spreadsheets or .rtf files either as standard format reports or as ad hoc reports, as appropriate.

4. Tool must track and compute value of potential cost avoidances during meeting preparation and also actual cost avoidances upon completion of transfers that effect the cross leveling of munitions.

5. Tool must send emails to interested parties whenever a comment or change is made on any line impacting items potentially being considered for cross leveling. This feature would need to be able to be turned off during the annual meeting. Some examples of the times these emails would be issued would be:

a. Authorized user inputs a list of items to be considered for cross leveling.

b. Authorized user checks off a box requesting logistic information at the lot level of items available for one cross-leveling action.

c. Authorized user inputs logistic information at the lot level for their offered items.

d. Authorized user inputs meeting minute support information regarding decisions and notes from the annual meeting. This one might be accomplished by turning the email notification feature back on at the end of the meeting.

e. Authorized user chooses to accept the offered items.

f. Authorized user inputs shipping transaction information indicating cross leveling has been accomplished.

6. Tool would tally up and provide details for actual cost avoidances achieved each fiscal year through cross leveling of Class V conventional ammunition. This output would be exportable in spreadsheet form.

7. Tool must allow for previous year's information to be output to computer records in a format that can be used for researching historical information to include offered items, accepted items, cross leveled items, notes regarding reasoning behind transfers, and values for all transactions.

8. To assure the functionality of the tool meets requirements, is usable, and is able to be supported during future changes, this tool should have a Functional Requirements Document, a Detailed Design Description, and a User's Manual.

9. Upon completion Products would be provided to the U.S. Government for use and for future modification without special compensation.

E. BENEFIT TO STUDENT:

1. Teach the process for developing software support documentation. While this is merely a computer tool, this project has been structured to require the major support documentation required for support of a computer system.

2. Provide project for developing computer code in support of acquisition logistics requirements.

3. Provide project to learn interfacing with customer to define project in terms understandable to user and programmer.

F. SUPPORT AVAILABLE:

1. This office (The Office of the Executive Director for Conventional Ammunition) understands that it would be required to fund a certain amount of travel to support the required research and to procure computer software and or hardware that might be needed to support this effort.

2. An electronic instructional guide is available to show how the current process puts the various inputs together to produce the materiel for the annual Quad Service Review cross leveling meeting and the meeting minutes.

3. A website is available for loading the final product.

4. Ms. Diane M. Smith, Senior Logistics Management Specialist, Office of the Executive Director for Conventional Ammunition, ATTN: AMXED-D, 5001 Eisenhower Ave, Alexandria, VA 22333-0001 *[additional information removed]* is available to provide support and coordinate this project. Ms. Smith has previously worked with programmers during system development to provide user requirements, to assist programmers with understanding the functionality of those requirements, and to beta test programs. As needed, she can meet with the student or call a meeting of all of the principal Service representatives to assist the student in developing the functional requirements documentation. The O/EDCA is a jointly staffed office located in Alexandria, VA which provides support to the Army in its Executive Agent role of the Single Manager for Conventional Ammunition.

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